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ABSTRACT

In 1984 the Urban Mathematics Collaborative (UMC) project was initiated to improve mathematics education in inner-city schools and to identify new models for meeting the ongoing professional needs of teachers. UMCs are located in Cleveland, Minneapolis-St. Paul, Los Angeles, Philadelphia, San Francisco, Durham, Pittsburgh, San Diego, St. Louis, Memphis, and New Orleans. In addition, two other projects were established: a Documentation Project to monitor the activities of the new collaboratives and a Technical Assistance Project to serve as a source of information for the collaborative projects. In each of the 11 cities, the UMC project supports collaboration among groups of mathematicians from high schools, higher education institutions, and industries, and encourages teacher participation in a broadly based local mathematics community. This report presents an overview of the efforts of the UMC project as a whole, as well as a brief description of each of the collaboratives and the Technical Assistance Project. The Appendix of the report includes a detailed progress report for each of the projects for the 1986-87 school year. (PK)

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Program Report 88-1

THE URBAN MATHEMATICS COLLABORATIVE PROJECT: REPORT TO THE FORD FOUNDATION ON THE 1986-87 SCHOOL YEAR

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Report from
the Urban Mathematics Collaborative Documentation Project

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Madison, Wisconsin

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I. INTRODUCTION

In 1984, the Ford Foundation initiated the Urban Mathematics Collaborative (UMC) project to improve mathematics education in inner-city schools and to identify new models for meeting the ongoing professional needs of teachers. In February, 1985, the Ford Foundation awarded five grants to establish urban mathematics collaboratives in Cleveland, Minneapolis-St. Paul, Los Angeles, Philadelphia and San Francisco. In addition, the Ford Foundation established a Documentation Project to monitor the activities of the new collaboratives and a Technical Assistance Project (TAP) to serve as a source of information for the collaborative projects (Romberg & Pitman, 1985). During the next eighteen months, UMC projects were funded in Durham, Pittsburgh, San Diego, St. Louis, Memphis, and New Orleans, bringing to eleven the total number of urban mathematics collaboratives (Romberg, Webb, Pitman, & Pittelman, 1987). A map of the UMC project appears in Figure 1.

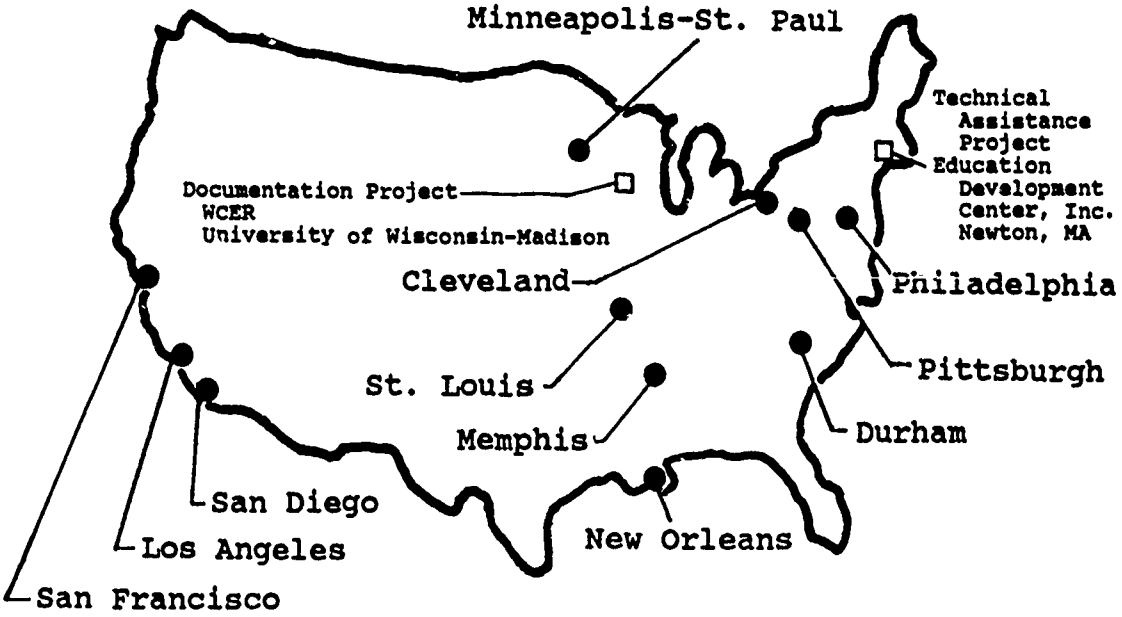
In each of the eleven cities, the UMC project supports collaboration among groups of mathematicians from high schools, higher education institutions, and industries, and encourages teacher participation in a broadly based local mathematics community. The teacher remains the centerpiece of the educational enterprise but--especially in inner-city schools--is likely to be overworked, lacking in support services and material resources, and isolated from other teachers, other professional adults, and changing ideas about mathematics.

The collaborative project is rooted in the premise that collegiality among professional mathematicians can reduce teachers' sense of isolation, foster their professional enthusiasm, expose them to a vast array of new developments and trends in mathematics, and encourage innovation in classroom teaching. The Ford Foundation's concomitant commitment of human and financial resources provides the needed support network to allow such collegiality to take place.

The urban mathematics collaboratives have assembled local resources--both financial and human--and have configured them in a variety of ways to explore new modes of professionalism for teachers and new kinds of relationships between high school mathematics teachers and the professional users of mathematics in higher education and in business. Considered individually, the collaboratives are unique, locally controlled projects. Together, they comprise an efficient, cost-effective, and comprehensive field experiment that will contribute valuable knowledge to the specific teachers involved, and serve as a testing ground for new modes of enhancing teachers' knowledge about mathematics and professionalism.

THE URBAN MATHEMATICS COLLABORATIVE PROJECT

Funded by
The Ford Foundation



- Cleveland Collaborative for Mathematics Education (C^2ME)
 Cleveland, Ohio
- Durham Collaborative: The Durham Mathematics Council
 Durham, North Carolina
- Los Angeles Urban Mathematics/ Science Collaborative (LAUM/SC)
 Los Angeles, California
- Memphis Urban Mathematics Collaborative
 Memphis, Tennessee
- New Orleans Mathematics Collaborative (NOMC)
 New Orleans, Louisiana
- Philadelphia Math Science Collaborative
 Philadelphia, Pennsylvania
- Pittsburgh Mathematics Collaborative
 Pittsburg, Pennsylvania
- St. Louis Urban Mathematics Collaborative
 St. Louis, Missouri
- San Diego Urban Mathematics Collaborative
 San Diego, California
- San Francisco Mathematics Collaborative
 San Francisco, California
- Twin Cities Urban Mathematics Collaborative
 Minneapolis-St. Paul, Minnesota

Figure 1. The Ford Foundation National Network of Urban Mathematics Collaboratives.

Consonant with the Foundation's original intent, each of the eleven collaboratives has been encouraged to develop as a unique program, drawing on local resources, exploiting local strengths, and addressing local weaknesses. As the effort continues, it will focus more specifically on the effects of the developing networks on the professional lives of the participating teachers and on the identification of issue-based outcomes. The Foundation's intent in the UMC effort is in keeping with the recommendations of the Conference Board of the Mathematical Sciences (1984):

> The Conference recommends the establishment of a nationwide collection of local teacher support networks to link teachers with their colleagues at every level, and to provide ready access to information about all aspects of school mathematics. (p. 5)

The broad sense in which the term colleague is used is exemplified by the objectives "strongly endorsed by the Conference":

- to extend the sense of professionalism among teachers by building a support system that links them to colleagues in the mathematical sciences, inside and outside of the schools;

- to provide teachers at all levels with colleagues upon whom they can call for information concerning any aspect of school mathematics; and

- to enable teachers to enlarge their views of mathematics, their source of examples, and their repertoire of classroom skills in communicating mathematics. (CBMS, 1984, p. 15)

It has been the Foundation's aim to involve virtually all of each participating site's high school mathematics teachers in a diverse set of school-year and summer activities, jointly designed and operated by teachers and mathematicians from educational, cultural, and business institutions. In these networks, mathematics teachers will be participants who bring to this exchange their unique viewpoint and experience, rather than clients who "receive" information from other partners in the relationship.

The Documentation Project records the progress of each collaborative in defining, redefining, and refining its focal concerns. The efforts of each project, as well as those of the Ford Foundation itself, merit study for three reasons. First, each project and the Ford Foundation need to be kept informed about what is happening; ongoing activities, the strategies employed, and the effects of those activities on the professional lives of teachers and other project participants need to be documented in order to be shared. Second, it is important for the projects, the Ford Foundation, and the educational policymaking community to

understand the characteristics and relationships inherent within each project. Because changes occur slowly over time, the activities, the actual changes in behavior, the anticipated and unanticipated outcomes, and the impediments encountered under varying circumstances must be identified and studied. Third, although we expect each site to be unique, we are confident that the data will enable us to identify project activities and strategies that can be generalized to different settings. By encouraging mathematics teachers to act as self-directed professionals, the collaboratives are providing lessons that can be applied to teachers of all subjects.

On-site data about the collaboratives' activities has been collected from a variety of sources, including:

1. the directors and coordinators of each project;
2. the on-site observers from each project (reflecting the teachers' perspectives);
3. visits by the staff of the Documentation Project;
4. joint meetings with personnel from the Ford Foundation and the Technical Assistance Project;
5. meetings of the project directors;
6. meetings of representatives of all of the projects; and
7. surveys administered to participating teachers.

This report presents an overview of the efforts of the UMC project as a whole, as well as a brief description of each of the collaboratives and the Technical Assistance Project. The Appendix of the report includes a detailed progress report for each of the projects for the 1986-87 school year.

II. PROJECT DESCRIPTIONS

A brief description of each of the eleven Urban Mathematics Collaboratives is presented in this section. A description of the Technical Assistance Project follows. (A more detailed report of each collaborative is appended to this paper.)

teachers in the Cleveland Public Schools. The collaborative has established a multi-purpose Resource Center for mathematics teachers and publishes its own quarterly newsletter.

Durham Collaborative: The Durham Mathematics Council

Director: Dr. J. Keith Brown
Executive Director: Dr. Jo Ann Lutz
On-Site Observer: Ms. Betty Peck
Funding Agent: The North Carolina School of Science and Mathematics
Date of Initial Funding: August 1, 1985

The Durham Mathematics Council was established in August, 1985, as the sixth collaborative in the Urban Mathematics Collaborative project. The collaborative, which serves more than 100 secondary mathematics teachers in the Durham city and county school systems, is administered through the North Carolina School of Science and Mathematics.

Since its inception, the project has identified five major areas for involvement to enhance professional growth for secondary school mathematics teachers. They are: enhancement of knowledge about local mathematics applications; expansion of currently limited opportunities for teachers to travel; support for teachers' growth as mathematicians; provision of opportunities for professional collegiality; and combating "burnout" and loss of professional self-esteem.

The project director and the executive director receive assistance in administering the affairs of the collaborative from the Board of Directors. The sixteen-member Board of Directors is comprised of representatives from area businesses, higher education, and the city and county school districts, including two teachers. The Steering Committee, comprised of one teacher from each school, was established to provide a direct link between the teachers and the collaborative administration.

The programs of the Durham Mathematics Council are designed to encourage junior and senior high school mathematics teachers to communicate with their colleagues in all areas of professional mathematics. Since its establishment, the council has sponsored seminars, workshops, and corporate-facility tours in North Carolina's Research Triangle area, using the resources offered by area businesses and universities. In summer, 1986, the council initiated an industry internship program and supported teacher participation in university study. Other activities included sponsoring seminars, workshops, and grants, establishing a Teacher Resource Center and efforts related to initiating the Triangle Mathematics Club. Throughout the 1986-87 school year, the council supported teacher attendance at professional meetings.

Los Angeles Urban Mathematics/Science Collaborative (LAUM/SC)

Executive Director: Ms. Peggy Funkhouser
Coordinator: Ms. Toby Bornstein
On-Site Observer: Mr. Richard Curci
Funding Agent: Los Angeles Educational Partnership
Date of Initial Funding: February 1, 1985

The Los Angeles Urban Mathematics/Science Collaborative (LAUM/SC) was organized in mid-1986 as a result of a restructuring and reorientation of the Los Angeles Urban Mathematics Collaborative, which was established in 1985 as one of the five original collaboratives. LAUM/SC is the official title of the thirty-five-member Advisory Committee to the funding agent, the Los Angeles Educational Partnership. The collaborative is responsible for four programs, one of which is the Ford Foundation-sponsored +PLUS+ (Professional Links with Urban Schools). The Advisory Committee is comprised of lead teachers from +PLUS+, Board of Education members, and representatives of the school districts directly involved, the County Office of Education, and foundations, museums, corporations, professional organizations, and postsecondary institutions.

The collaborative serves not only the entire Los Angeles Unified School District (LAUSD) but several nearby districts as well. Because of the massive potential target population, the collaborative's +PLUS+ program initially directed much of its attention to the mathematics departments in three high schools. The departments in these schools have formed +PLUS+ teams with business and postsecondary associates. In spring, 1987, five more schools were identified to participate. The +PLUS+ initiative involves two major efforts, one directed at the mathematics departments in the eight target schools and another at the mathematics teachers in forty-seven high schools in the Los Angeles area.

The goal of +PLUS+ is to assist teachers to relate the world of work to the mathematics curriculum and to benefit from expanded mathematical horizons through interaction with colleagues in a mathematics resource network. Within the +PLUS+ program, steering committees plan activities; these committees are comprised of teachers and business and college associates, all of whom are considered members of the +PLUS+ program. Members of the +PLUS+ teams in each of the target schools work together to prepare and execute plans for teachers' professional development. Considerable effort has been expended on building these teams, with the goal of creating and consolidating departmental cohesion. To this end, a series of dinner meetings with invited speakers was organized by and for the teams. Departments in target schools agreed to define

needs, explore resources, and develop a program of activities as prerequisites for financial support.

The efforts of teachers in the +PLUS+ program during the 1986-87 school year focused on planning a series of four mathematics content workshops for all regional mathematics teachers. Teachers served on planning teams for each workshop topic and in many cases also served as workshop coordinator. The collaborative also initiated a pilot summer internship program and funded attendance of +PLUS+ teachers at several local and national conferences.

Memphis Urban Mathematics Collaborative

Executive Director: Mr. Herman Ewing
Project Director: Ms. Nancy Gates
On-Site Observer: Ms. Rita Ross (appointed January, 1987)
Funding Agent: Memphis Urban League, Inc.
Date of Initial Funding: September 1, 1986

The Memphis Urban Mathematics Collaborative, which was the last collaborative to join the UMC project, serves a population of approximately 345 mathematics teachers in the Memphis City Schools, although its initial efforts have focused on the mathematics teachers in twenty targeted schools. The collaborative is administered through the Memphis Urban League, Inc.

The collaborative's goal is to promote professionalism among mathematics teachers and to assist them in broadening their horizons through creative relationships with other mathematics professionals.

The organizational structure for the collaborative has evolved over the course of its first year. The collaborative is governed by a nineteen-member Advisory Committee comprised of five teachers, five mathematics professors, and representatives from higher education, business, the school district administration, and the Urban League. Subcommittees of the Advisory Committee develop ideas for collaborative activities. The four subcommittees established are: Speakers Bureau, Resource Associate, Summer Workshops, and Internship. Plans are underway for the formation of a Teacher Committee. The Teacher Committee, to be composed of thirteen teachers, will provide a means of getting input from teachers in regard to the activities the collaborative should be planning.

During the 1986-87 school year the collaborative initiated several programs, including establishing a Speakers Bureau and printing a Speakers Bureau Directory, placing forty teachers with a college or business Research Associate, planning summer internships for four teachers, and planning a series of four workshops for the summer.

New Orleans Mathematics Collaborative (NOMC)

Director: Ms. Constance Barkley
Coordinator: Dr. Olympia Boucree
On-Site Observer: Ms. Aldonia Winn
Funding Agent: The Metropolitan Area Committee (MAC) Foundation
Date of Initial Funding: September 1, 1986

The New Orleans Mathematics Collaborative was the tenth collaborative to be funded by the Ford Foundation. The collaborative, which serves the approximately 150 senior high school mathematics teachers in the Orleans Parish Public Schools system, is one of four programs coordinated by the Metropolitan Area Committee Education Fund.

The goals of the collaborative are to enhance the professional development of the mathematics teachers and to enrich the teaching of mathematics. These are to be achieved by providing teachers with opportunities to develop networks of mathematicians, to work in collaboration with other teachers and mathematicians, to keep abreast of developments in mathematics and teaching, and to experience mathematics usage outside an academic setting.

The collaborative is governed by a twenty-member Steering Committee of teachers, district administrators, and representatives from the teachers' union, businesses, universities, and the Louisiana Science Centre. The Chair is a member of the MAC Education Fund Board. Four subcommittees oversee the collaborative's activities. They are: symposia, site visits and internships, workshops, and newsletter.

During the 1986-87 school year, the New Orleans Mathematics Collaborative offered a wide variety of activities, including a November 18 reception at the Louisiana Science Centre to officially launch the project, a symposium series, site visits to local businesses and industries, and several workshops. In addition, the collaborative encouraged teachers to apply for mini-grants and published its own newsletter.

Philadelphia Math Science Collaborative

Director: Dr. Wayne Ransom
Coordinator: Ms. Sue Stetzer
On-Site Observer: Ms. Joyce Neff
Funding Agent: The Franklin Institute
Date of Initial Funding: February 1, 1985

The Philadelphia Math Science Collaborative was formed in fall, 1986, through a restructuring and reorientation of the Philadelphia Mathematics Collaborative, one of the original five collaboratives. The collaborative, which serves mathematics and science teachers in six target high schools in the School District of Philadelphia, is administered through the Franklin Institute.

The goals of the Philadelphia Math Science Collaborative are to promote teacher leadership and team building and to contribute to a vision of mathematics teaching in the future. Specifically, the collaborative hopes to: (1) develop, evaluate, and document the position of an in-school collaborator who would facilitate communication and serve as a catalyst for change and (2) increase teacher participation in extramural professional development programs which offer partnership between teachers and their colleagues in academia and industry, opportunities to enhance knowledge, skills, and professionalism, and new ideas for mathematics instruction. The collaborative also hopes to develop a model for documenting the impact these two programs will have upon the quality of teachers' professional lives.

The collaborative is governed by a twenty-four-member Advisory Council, consisting of one teacher from each of the target schools, as well as representatives from various local colleges, businesses, the school district, PRISM (Philadelphia Renaissance in Science and Mathematics), and professional organizations. The Advisory Committee meets bimonthly to help evaluate and reshape existing programs, and to design new programs with an eye toward providing support to the coordinator and direction for the collaborative.

In addition to encouraging teachers to participate in the many programs provided for them by other organizations in the Philadelphia area and providing teachers in the target schools free memberships in their local professional organizations, the collaborative has offered several activities during the 1986-87 school year aimed specifically at the targeted teachers. These programs include mini-grants which enable teachers to attend professional meetings, workshops, and seminars; monthly departmental meetings, which have included guest speakers and reviews of educational software; a newsletter; a teacher's network

for mathematics in applications; and a clearinghouse service that keeps teachers notified of resources for classroom use.

Pittsburgh Mathematics Collaborative

Project Coordinator: Dr. Leslie Salmon-Cox
Assistant Project Coordinator: Dr. Martha Jacobs (through March 31, 1987)
Barbara Bridge (appointed April 15, 1987)
On-Site Observer: Ms. Rosemarie Kavanagh
Funding Agent: Allegheny Conference on Community Development
Date of Initial Funding: September 1, 1985

The Pittsburgh Mathematics Collaborative, serving the 126 high school mathematics teachers in the Pittsburgh public schools, was the seventh collaborative to be established. The collaborative is administered through the Allegheny Conference Education Fund, which is part of the Allegheny Conference on Community Development.

Six goals provide a focus for the collaborative: to overcome teachers' isolation through increased opportunities for interaction; to educate the community about the professional nature of high school mathematics teachers; to enhance teachers' knowledge of mathematics applications; to provide opportunities for professional self-enhancement; to provide opportunities for teacher recognition; and to provide time for teacher interaction, work, and professional development. These goals are envisioned as positive steps toward institutionalization of structures and processes that will foster teacher professionalism and that will be decreasingly reliant on external administration and facilitation.

Collaborative governance is shared among the twenty-nine-member Steering Committee and its Executive Committee, called the "First Tuesday Committee," and the department chairs from each of the twelve high schools. The Steering Committee, comprised of teachers, school district administrators, college and university faculty members, and representatives from various community councils, corporations, and foundations, meets twice annually to discuss the direction and activities of the collaborative. The department chairs meet monthly to plan and evaluate specific activities. The department chairs also serve as the major communication channel between the collaborative and the teachers.

During the 1986-87 school year, the Pittsburgh Mathematics Collaborative offered a wide variety of activities and programs designed to enhance professionalism and collaboration among teachers and professionals in the mathematical sciences, as well as to provide teachers with information about the applications of mathematics. These included receptions, seminars on uses of mathematics in the workplace, computer training, curriculum

development which included policies for the use of calculators, and tours of local industries. The collaborative also encouraged teachers to take advantage of professional opportunities provided by related organizations, such as professional conferences, lectures, and professional enrichment grants.

St. Louis Urban Mathematics Collaborative

Director: Ms. Judy Morton
On-Site Observer: Mr. James Richmond (appointed January, 1987)
Funding Agent: Mathematics and Science Education Center
Date of Initial Funding: April 15, 1986

The St. Louis Urban Mathematics Collaborative was one of the four collaboratives established in 1986. The collaborative, which serves the 104 mathematics teachers and 14 computer science teachers in the St. Louis Public School District, is administered through the Mathematics and Science Education Center.

The four primary goals of the collaborative focus on giving teachers the opportunity to explore business-, industry-, and university-based resources to determine how these resources may assist them in their professional growth and classroom instruction; to develop and implement staff training programs for themselves and for their peers; to improve communication and information exchange among mathematics teachers both within and across schools; and to promote recognition of accomplishments and quality performance among all mathematics teachers and students. These goals were derived from the expectation of secondary mathematics teachers that the collaborative would improve communication, collegiality, knowledge of mathematics and its applications, instructional expertise, and feelings of professionalism among the targeted teachers.

Some administrative duties in the collaborative are assumed by a Collaborative Council. During 1986-87, the Council consisted of eight teachers, one university mathematician, two mathematics supervisors from the St. Louis Public Schools, the director of the Partnership Program, and the collaborative director. The Collaborative Council, when fully staffed, will consist of ten teachers from the St. Louis Public Schools, two representatives each from the academic and business communities, three mathematics supervisors and two other administrators from the district, and the collaborative director. The Council meets once each month to discuss, plan, and evaluate collaborative events. Decisions are made by Council vote.

Many of the activities sponsored by the collaborative during the 1986-87 school year focused on gathering teacher input on and generating interest in programs to be offered in the future. Various planning meetings have been held to make teachers aware of the opportunities for professional growth which are available to them. As an initial activity, the collaborative funded teachers to

attend a conference designed to increase awareness of linkages between science, mathematics theory and technology. The collaborative also paid teachers during the summer to compile resource lists for distribution throughout the district. Development of the resource guide began in summer 1986 and will continue through summer 1987. Resources that were catalogued included people and organizations; data communications, books and journals; videotapes and films; and computer software. The collaborative also organized summer site visits to area businesses, sponsored grant writing seminars during which mathematics teachers were informed about grants that were available, and funded teachers to go to a variety of seminars.

San Diego Urban Mathematics Collaborative

Director: Prof. Alma Marosz
Coordinators: Mr. Frank Holmes
Ms. Beth Schlesinger
On-Site Observer: Dr. Sharon D. Whitehurst
Funding Agent: San Diego State University Foundation
Date of Initial Funding: April 15, 1986

The San Diego Urban Mathematics Collaborative, established in spring, 1986, is administered through the San Diego State University Foundation. During the 1986-87 school year, the collaborative served sixty-six mathematics teachers from six targeted schools: a senior high school and its two feeder schools in each of the Sweetwater Union High School District and the San Diego Unified School District.

The primary goal of the collaborative is to improve the professional life of mathematics teachers in the San Diego area by reducing the tendency to work in isolation and by increasing the contacts that foster mutual support, professional growth, and involvement with the larger professional mathematics community.

The collaborative is governed by a project director, two project coordinators, and the Executive Committee consisting of mathematics specialists from the city and county, teachers who were involved in writing the proposal, and teachers from the targeted schools, as well as a faculty member from San Diego State University and the collaborative director and coordinators. The major thrust of the Executive Committee's efforts currently is directed toward instilling in teachers a sense of project ownership.

In addition to encouraging teachers to take advantage of a wide array of local resources, the collaborative has hosted a wine-and-cheese reception, an evening dinner colloquium and social, summer workshops at San Diego State University, a mini-course in discrete mathematics, a workshop on technology in the classroom, and an evening retreat. The collaborative also has paid the membership dues of the Greater San Diego Mathematics Council for all the mathematics teachers in the six targeted schools and offered stipends to teachers to attend several conferences and workshops, including the fall conference of the Southern Section of the California Math Council, the national NCTM conference and the Conference on Computers in Secondary School Mathematics at Phillips Exeter Academy.

San Francisco Mathematics Collaborative

Executive Director: Ms. Gladys Thacher
Director of Development & Community Outreach: Ms. Janice E. Toohey
Project Director: Ms. Wandaline Perelli
On-Site Observer: Ms. Joanne Pamperin
Funding Agent: San Francisco Education Fund
Date of Initial Funding: February 1, 1985

The San Francisco Mathematics Collaborative was one of the five original collaboratives established in 1985. The collaborative, which serves the 105 mathematics teachers in the San Francisco Unified School District who hold a major, minor, or advanced degree in mathematics, is administered through the San Francisco Education Fund.

The goal of the San Francisco Mathematics Collaborative is to show teachers "how mathematics is imbedded in the world around us, while being sensitive to the needs and interests of the teachers involved in the program." In light of this goal, collaborative efforts focus on developing leadership skills in teachers and department heads through seminars and opportunities to attend conferences; building collegiality among teachers and networks between teachers and other mathematics professionals; and enabling teachers to infuse into their instruction a sense of imbeddedness of mathematics in the real world.

The collaborative's Steering Committee and Teacher Advisory Committee provide input to the project director. The Steering Committee, comprised of the Executive Director of the San Francisco Education Fund, representatives from the Exploratorium, San Francisco State University, the University of San Francisco, San Francisco Community College, San Francisco Unified School District, and the private sector, as well as two members of the collaborative's Teachers' Council, meets monthly to develop and implement policy, to monitor and evaluate activities, and to plan future activities. The Teachers' Council was reorganized during the spring to include six teachers and the project director as an ex-officio member. In addition to these two committees, the Tripartite Council provides the collaborative contact with those from business and higher education.

During the 1986-87 school year, the San Francisco Mathematics Collaborative offered a wide variety of activities that enabled teachers to form networks with their peers and with other professionals, and to increase their awareness of the developing world of mathematics and its applications. The 1986 Summer Institute at the Exploratorium, as well as follow-up sessions,

exposed teachers to applications of mathematics in the physical sciences. A series of Dinner Lectures brought teachers together with distinguished professionals in the mathematical sciences and provided an opportunity for collegiality and for bridging the gap between mathematical theory and application in the worlds of commerce, industry and technology. Mini-grants also were made available to teachers for projects designed to enrich students' mathematics education. In spring, 1987, the collaborative sponsored a series of workshops on discrete mathematics.

Twin Cities Urban Mathematics Collaborative

Director: Prof. Harvey B. Keynes
Teacher Coordinator: Ms. Sally Sloan
On-Site Observer: Mrs. Gerry Sell
Funding Agent: School of Mathematics, University of Minnesota-Minneapolis
Date of Initial Funding: February 1, 1985

The Twin Cities Urban Mathematics Collaborative was one of the five original collaboratives established in 1985. The collaborative, which serves about 200 mathematics teachers in the Minneapolis and St. Paul school districts, is administered through the School of Mathematics at the University of Minnesota.

Since its inception, the project has directed its efforts at helping teachers to exercise more control over their professional lives; at providing professional and educational opportunities to teachers; at expanding the involvement of business and industry; at integrating its efforts with those of other mathematics education organizations; and at increasing its visibility, especially within the school district.

The collaborative's director receives input from a Steering Committee and a Teacher Advisory Committee. The Steering Committee, which oversees collaborative activities, is comprised of teachers, mathematics supervisors, representatives from local industries, area universities and colleges, and the Science Museum of Minnesota. The Teacher Advisory Committee is composed of five teachers who participated in one of the collaborative-sponsored Summer Institutes, and the teacher coordinator. The committee serves as an advocate for ideas generated by teachers from both within and outside the committee and acts as a sounding board for the Steering Committee. Two members of the Teacher Advisory Committee also serve on the Steering Committee. The collaborative is in the process of identifying a building representative for each public and private secondary school. This representative would serve as the collaborative's emissary for the teachers in his or her school.

During the 1986-87 school year, the Twin Cities Urban Mathematics Collaborative sponsored a wide variety of activities for both junior and senior high school mathematics teachers. These included the 1986 Summer Institute, which focused on problem solving and enrichment topics for the junior high curriculum; an Academic Year Seminar series in conjunction with the NSF Teacher Renewal Project, a series of dinner lectures; and meetings of the Minnesota Mathematics Mobilization. In addition, the collaborative publishes its own newsletter, which is an important networking

component of the project. The newsletter is co-edited by the teacher coordinator and the on-site observer.

Technical Assistance Project

Coordinator: Dr. Mark Driscoll
Program Assistant: Ms. Melissa Fox
Technical Assistant: Ms. Grace Kelemanik
Funding Agent: Education Development Center (EDC)
Date of Initial Funding: September 1, 1985

The Technical Assistance Project (TAP) was established in September, 1985, to provide technical support to the Urban Mathematics Collaborative project. The TAP, which is funded through the Education Development Center (EDC), was formed in response to individual collaborative's requests for extra support and increased information. The TAP's staff of three draws on other EDC staff, as well as on resources in the mathematics and education communities.

The Technical Assistance Project focuses its activities on four goals: to provide the collaboratives with a network of resources for information on mathematics and mathematics education; to provide opportunities for collaborative members to participate in national and regional symposia, workshops, and pilot projects; to establish communication networks among the eleven collaboratives; and to provide assistance in solving local problems and identifying local resources.

The Director of the Technical Assistance Project has visited all the collaboratives at least once during the year to gain a better understanding of local issues and needs. EDC resources have been used to disseminate information on a wide range of issues and to identify local human resources. A computer network, established in fall, 1986, facilitates communication among the collaboratives, and a quarterly newsletter helps to disseminate information to the collaboratives. EDC published a brochure that describes the UMC project and lists the names and addresses of the directors of the eleven collaboratives. The TAP was responsible for organizing the annual meeting of collaborative project staffs. In addition, TAP funded teachers from various collaboratives to meet together and sponsored teachers' attendance at national conferences. This year the Technical Assistance Project initiated a meeting of the district mathematics supervisors in cities in which collaboratives are located and also sponsored activities for UMC participants at the NCTM Annual Meeting.

III. OBSERVATIONS AND REFLECTIONS

Our observations and reflections about the eleven urban mathematics collaboratives and the UMC project as a whole are organized under four topics: project development/management, collaboration, professionalism, and mathematics focus. These four topics have been chosen because they represent the major issues that the collaboratives are addressing. Our observations regarding each collaborative, which are included in the Summary Reports appended to the complete report, also are organized under these headings. In this section, activities and developments across collaboratives during the 1986-87 school year will be discussed. Aggregating the information that has been collected site by site provides insight into the project, its richness, and its difficulties. While a review of the evolution of each site reveals distinct differences among them, it is clear that common problems and issues are being addressed by all eleven collaboratives.

The underlying assumption of the Urban Mathematics Collaborative project is that collaboration between high school teachers and other mathematics-using professionals in higher education and in business will enhance the teaching and learning of mathematics in inner-city schools. This enhancement can be viewed as the end product of the project's efforts to reduce the isolation of teachers; to boost professional enthusiasm; and to create an environment conducive to generating new ideas, discriminating among options, and encouraging resourcefulness. From the project's onset, collaboration has been loosely defined as establishing relationships and sponsoring activities between high school mathematics teachers and other mathematics-using professionals.

PROJECT DEVELOPMENT/MANAGEMENT

Associated with the stages of collaboration are the stages of development and changes in management that occur as the projects come into being, grow, and work toward permanence. During the 1986-87 school year, the newer sites devoted their time and energies to defining roles and deciding how best to get the individual projects underway. In general, the older projects have in the past year become more comfortable with their organizational structure and have begun to experience a sense of stability. Consistently across the sites, however, adjustments in organizational or administrative structure have been necessary. In some cases, this adjustment has involved redefining collaborative goals; two collaboratives have expanded their focus to encompass science. In others, it has required a more explicit articulation of committee and administrators' roles. Some collaboratives have changed the membership of their advisory committees or replaced

approach businesses and industries and to invite their participation in the project. Fund raising activities have resulted in contacts with the business sector that have led to other forms of collaboration. The absence of the need for fund raising, because a collaborative functions under an umbrella organization that takes the responsibility for funding, eliminate one reason for approaching business. In some cases, this may have affected the level of involvement in the collaborative by the business sector.

All eleven collaboratives have established a Steering Committee or Teacher Advisory Council. The success of these committees varies by site. Nonetheless, each collaborative has a committee that has the potential to provide teachers with input in the decision-making process.

By design, various types of funding agents are involved in the project. Five sites are funded through some form of public education fund. Other funding agents include a university, an urban league, a residential public high school for academically gifted students, a mathematics and science center, a university foundation, and a science museum. An unexpected outcome at some sites is that funding agents have assumed different roles because of their relationship to a collaborative. The very nature of collaboration has meant that funding agents are becoming as involved with human resources as they traditionally have been with financial matters. The public education funds, in addition to obtaining and distributing resources, have, for example, cooperated in coordinating activities. The director of the Twin Cities collaborative, which is funded through a university, has become involved in soliciting contributions from local districts and businesses. For the first time, the director of the Cleveland Education Fund is writing a grant proposal to the National Science Foundation. The Memphis Urban League, with the long-range goal of improving the academic performance of black underachievers, has become involved in efforts to improve mathematics education for all Memphis students.

Another reason that funding agents have assumed new roles is that collaborative success depends as much on forming relationships and networks as on acquiring funding and administrative support. Thus, funding agents are being asked to identify and to contact representatives of business and higher education to encourage their participation in collaborative activities. Advisory board members provide valuable advice and opinion, but they also contribute key information about those in their organizations who might be willing to donate time and energy to the collaborative. Where the school district once turned to the funding agent for money, collaboration requires that the two work together, meet with each other, plan, and coordinate schedules.

Nearly all sites have experienced structural changes in committees, boards, or administrative roles. But these changes have been made and the sites are progressing; this progress is

evident as the mature sites address more substantive issues related to permanence, teacher decision making, conditions of teaching, and relationship with the school district.

As each collaborative evolves, it develops a unique personality. But the issue of institutionalization is one that must be confronted by all eleven sites, as well as by the Technical Assistance Project as it develops strategies for supporting the projects. The direction taken by the collaboratives in addressing this issue will help to validate current efforts to gain the attention of the community, to involve teachers, and to develop an organizational structure that can support the administrative tasks of collaboration.

COLLABORATION

The UMC project has been in operation since 1985. As the project evolves, so does the meaning of collaboration. A key element of collaboration is forming relationships among individuals; these relationships seem to evolve in stages. The first phase involves eliminating barriers and becoming acquainted. In later stages, significant interactions develop in which individuals gain from the relationship and become bonded to it so that they actively seek its continuation.

All sites have been engaged in generating activities to promote collaboration. Many activities have provided opportunities for teachers to interact and to become better acquainted. Others have focused on developing relationships and team building. Others, particularly those involving mathematicians from business and universities, were designed primarily to relay information to teachers about mathematics and its applications. What varied from one activity to another were the kinds of relationships being encouraged, the interactions that occurred, the groups or sectors involved, and the type of planning that took place prior to the event. While the activity itself is important, the sites are finding that the planning phase can be even more instrumental in promoting collaboration.

It takes a considerable amount of time to form relationships that result in significant interactions from which individuals draw specific benefits. Because the sites are in their formative stages, our observations at this point are based on an incomplete process. It is apparent, however, that the sites have organized a wide range of activities with a variety of results. Our discussion will first focus on teachers and the relationships that have been established both between teachers within a school and between teachers across schools through activities or involvement with the collaborative. We will then address the relationships that are beginning to form between teachers and other mathematics-using professionals.

At this point in the UMC project's development, the most significant relationships formed as a result of collaboration have developed between teachers. Teacher-teacher relationships have been strengthened within schools and across schools within districts.

Within-School Interaction

In their proposals, a number of the sites identified goals that focused on eliminating the barriers that isolated teachers. While each of these sites is striving to establish networking, collegiality, community, and mutual support among teachers, there is a great deal of variation in the level of relationships emerging among mathematics teachers. If one believes that to enhance their professionalism and to network, teachers must feel a sense of group membership, then the mathematics department within a school may be considered a logical place for teachers to begin to share information and to participate in professional activities. There is, however, wide variation in how mathematics departments function across the eleven sites and even within individual districts. In some schools, the mathematics department is little more than a roster of mathematics teachers. Some departments meet weekly, while others do not meet at all. Most departments have very little, if any, sense of power or group identity. The authority of the department head varies across sites, and even within a school district, from delivering mail, as described by one mathematics department head, to having the authority to assign teachers to classes and to participate in faculty selection.

Because departments function so differently, collaboratives have chosen a variety of strategies by which to foster working relationships within them. Some projects have used the department as a foundation for building collaboration, enhancing the teaching of mathematics, and organizing activities. The Los Angeles collaborative, for example, has made a concerted effort to develop in-school teams using the school departments as a base. Its strategy focuses on involving at least 60 percent of the mathematics teachers within a department in writing a grant proposal that is submitted to the +PLUS+ program. As a result, teachers work together to develop and produce an action plan for a specific school year. The collaborative facilitated the process by offering team-building workshops and grant-writing training. As a result, new relationships have begun to emerge among teachers who may have been teaching in neighboring classrooms but had not interacted to any degree. At the end-of-year sharing meeting in June, 1986, +PLUS+ teachers talked about what had been accomplished as a result of the collaborative. One teacher commented, "My department certainly has grown." In one school, teachers within a department began to meet regularly over lunch and to plan other group activities. Becoming acquainted, both professionally and socially, seemed to facilitate other developments, such as increased use of the Geometric Supposer and teachers working

together to plan the collaborative-sponsored workshops for other district teachers. The fact that not all department members from this particular school became involved indicates that group cohesion or membership is not as important to some mathematics teachers. Some teachers remained isolated, either by choice or because of other commitments, such as coaching. It should be noted, however, that more mathematics teachers became involved in writing the action plan during the second year of the program, which supports the idea that forming relationships takes time. Having teachers from a department work and plan together has helped teachers view each other in new ways. At the April, 1987, +PLUS+ Proposal Planning Meeting a teacher reported, "My department and I learned some things about ourselves we didn't know. Now that is worth our time."

San Diego also has chosen to focus some of its efforts on local school mathematics departments. In initiating the collaborative, the project coordinators met the department heads of each of the six targeted schools. One department had not met in recent memory; with the help of the collaborative coordinator, a department meeting was held. At this meeting, which was attended by an assistant principal, teachers discussed some problems they had experienced but had not been able to communicate to the school administration. As a result of the meeting, a new relationship was formed between the mathematics teachers and the administrator. As in Los Angeles, mathematics teachers in San Diego have begun to relate to their peers somewhat differently. Impetus from the collaborative has prompted the department to develop from a collection of individual teachers into a functioning unit that can work for the professional benefit of all of its members.

The Philadelphia collaborative faced a very different situation. Departments are required to meet monthly. As a result of collaborative encouragement, some departments in the targeted schools began to apply for and to use grants to support a variety of professional enrichment activities during department meetings, as well as at other times. In one high school, mathematicians from nearby universities led problem-solving workshops during department meeting times. In other schools, teachers received computer training and began to view one another as resources when problems arose. In another school, the mathematics and science departments began to meet together and to develop a relationship that would foster coordination in the teaching of the two content areas. The exact role of the collaborative in creating change in these departments is somewhat cloudy. It is clear that the collaborative provided the personal attention of its coordinator, who monitored the activities and intervened when necessary; this attention certainly was instrumental in initiating the activities and in sustaining them over time. Clear results of the departments' role in the professional development of teachers are difficult to determine. However, the activity itself speaks to the value of encouraging teachers to relate to one another in different ways--solving problems together, discussing problem solving, and helping one another learn more about computers.

The Pittsburgh collaborative has provided teachers the opportunity to share with their colleagues by offering activities in which they can participate together. In the Pittsburgh school district, groups of high schools are assigned the same teacher in-service days. The collaborative took the initiative and scheduled industrial site visits for mathematics teachers on those in-service days; because the in-services were mandatory, all mathematics teachers from the participating schools shared the experience.

Groups of teachers from the same departments in the Twin Cities arranged to attend the Summer Institutes so they could work together during the year on topics discussed in the Institute. As a result, teachers at one high school initiated study groups with their students. The fact that three of the twelve teachers in the department had attended the Institute helped them to implement the new program.

In some collaboratives, mathematics teachers within schools are relating to each other in new ways that can, at least to some degree, be attributed to collaborative involvement. A Philadelphia teacher articulated the problem, "Teachers are so burdened that it is like we are on an assembly line and there is no time to talk." In some cases, new relationships have resulted from teachers working more cohesively as a department or experiencing professional growth together as they learn more about mathematics. In other cases, these new relationships involve sharing a common activity or experience. In many cases, it is clear that teachers who have worked in the same school for a number of years are now beginning to relate to one another in new ways.

Across-School Interactions

Teachers in all eleven collaboratives have expressed their appreciation for opportunities to meet and socialize with their school-district colleagues. At a May, 1987, Triangle Mathematics Club meeting in Durham, a teacher commented, "I often get discouraged--evenings like this cheer me up--I can go back to class and try again." Nearly all collaborative activities--symposiums, workshops, dinner meetings, institutes, site visits, and committee meetings--provide this valuable opportunity for networking and sharing. Prior to these activities, interaction among teachers often was restricted to colleagues in a single school--if it occurred at all. There are, however, several reasons why teachers had not interacted with their peers from other schools. The first involves scale; inner-city school systems in the UMC project, with the exception of Durham, range in size from twelve high schools in Pittsburgh to forty-seven high schools in the Los Angeles area. Typically, only a very few district activities congregate teachers from across schools; these may include, for example, textbook selection committee meetings and district-wide in-service days. Theoretically, while professional organizations may provide the

opportunity for teachers to interact, many teachers do not belong to professional organizations, and many who do, do not attend meetings. Teachers' enthusiasm for collaborative events that foster personal interaction suggests that a void in teachers' professional experience existed prior to collaborative involvement.

As a result of collaborative activities, teachers in the eleven sites are forming new relationships or strengthening former relationships with other teachers throughout their district or, in some cases, across districts. Initially, many sites sponsored some form of ice breaker, during which teachers were able to meet and become better acquainted. As the collaboratives evolved and began to develop activities to meet local needs, interaction among teachers depended on individual activities and varied from site to site.

Some sites have made concerted efforts to develop opportunities for teacher networking. In Durham, two networking groups, one focusing on geometry and the other on algebra II/precalculus, allow teachers to review and evaluate new curriculum materials or software. In other sites, networks have been established to share teacher-developed materials. Teachers who participate in the Summer Institute in the Twin Cities provide, on request, the module they prepared and tested with their own students. In Philadelphia, a network is being established for teachers of the Mathematics in Applications course. Materials prepared by teachers will be distributed to all teachers in the network. Memphis is planning swap shops, while Los Angeles anticipates linking teachers through an electronic network. As noted by one Philadelphia teacher at a collaborative evaluation and discussion meeting in May, 1987, "It was good to talk to each other because we don't often have that opportunity. It was nice to learn what is happening in other schools."

The collaboratives are using a variety of approaches to facilitate communication among teachers, and to help teachers keep one another informed of collaborative-sponsored events and other professional activities. Six of the collaboratives send newsletters to all collaborative teachers. Most of these include articles or listings about collaborative- and district-sponsored activities of interest to mathematics teachers, as well as information about grants awarded to mathematics teachers, new ideas about mathematics instruction, and innovative ideas teachers are implementing in their classrooms. Collaboratives without newsletters disseminate information through such means as notices to the department heads or regular mailings. In the Twin Cities, a representative at each high school has been identified who disseminates information as one responsibility.

In addition to these more formal contacts, teachers are forming networks on a personal level with other teachers they have met at collaborative activities. A San Francisco teacher with four years experience, who is teaching calculus for the first time, began networking with a more experienced calculus teacher he met at

a collaborative-sponsored Nobel lecture. This type of networking provides a service that is especially valuable to those inner-city teachers who are the only ones in a school who teach a given course, or who, as in San Francisco, are teaching mathematics courses without a major or minor in mathematics.

In Cleveland, teachers developed and continue to run a resource laboratory for all mathematics teachers in the district. Teachers who staff the lab serve as a valuable resource to their colleagues; during the 1986-87 school year, lab resource teachers conducted workshops. The lab staff also makes computers available for teachers' use and offers bulk pricing on such supplies as computer disks. The teacher-directed workshops in Los Angeles and a presentation by teachers to the Mathematics Society in the Twin Cities are other examples of collaborative teachers serving as resources to their peers.

A new relationship has developed among the mathematics teachers who participate in the collaboratives, and between the teachers as a group and their local school district administration. All of the collaboratives operate in the context of a school system that has its own administrators, rules, mandates, and procedures. In many sites, the collaborative is beginning to assume an identity as an organization of mathematics teachers that can take on certain responsibilities and provide a service to the district. In many cases, however, a district's willingness to accept teacher input on important issues has emerged only after prodding by the collaborative. Such was the case in Pittsburgh where, through the efforts of the collaborative coordinator and the district associate director of mathematics, the district superintendent assigned the committee of department heads the responsibility to design the third-year mathematics course. The department heads, who now meet monthly, had been a group in name only prior to their involvement with the collaborative. Monthly meetings and a common purpose has transformed this loosely affiliated group of individuals into a cohesive unit that enjoys its work and provides a vital service to the district. While the opportunity for teacher interaction had great appeal, recognition of a common goal and task fostered a sense of group interdependency and cooperation.

Another form of teacher-to-teacher bonding appears to be developing among teachers who assume representative roles for the collaborative's general membership. Some collaboratives have appointed five or six teachers to an advisory board or council. As advisory board members, these teachers help make decisions that guide and influence the collaborative. As representatives of their peers, they play a key role in providing a teacher's view and perspective and in offering other teachers the opportunity to have their positions voiced.

The Steering Committee in Durham, which includes one teacher from each of the fourteen schools, has developed a strong sense of group identity. Monthly meetings and the group's role as a conduit of information between the collaborative director and the teachers

have stimulated interpersonal bonding to the extent that teachers were resistant to a proposal that they resign their positions to allow other teachers the opportunity to serve on the Steering Committee. A similar process occurred in St. Louis, where the Collaborative Council consisted mainly of teachers making decisions about the collaborative's focus and role. What appears to be a common factor among these sites is that a group of teachers meets regularly with an explicit objective or goal to achieve. The influence of a facilitator who helps to convene the group also seems to be important in the beginning.

Across Boundaries

An underlying assumption of the UMC project is that establishing collaborative relationships between school mathematics teachers and other mathematics-using professionals in higher education and business can enhance the professional lives of the teachers and positively affect mathematics education in the schools. All sites, except St. Louis, have representatives of business and higher education serving with teachers on an advisory board or council. St. Louis, at the close of the 1986-87 school year, was working to identify a representative from local business to serve on its collaborative council. While these boards have functioned with varying degrees of effectiveness, in all cases collaboration is occurring among board members as they participate in board business. Members from the various sectors share equal status in decision making, in defining collaborative activities, and in determining the collaborative's role and identity. The advisory board structure also fosters a deeper understanding between secondary teachers and people from business and higher education. In a group discussion in Durham, for example, a business representative voiced his dismay about a young salesclerk who could not make proper change, and a teacher described her frustration with the meager salaries teachers receive.

Inclusion of representatives from various sectors on a board or council does not guarantee positive or productive interaction. In light of this, some collaboratives have successfully organized smaller groups to focus on particular functions, such as planning workshops or scheduling site visits. Identification of a specific task or goal seems to generate more interaction and involvement from committee members.

Another form of collaboration occurs when a business or university representative serves as a resource. All eleven sites have involved people from higher education and business in this way. In the Twin Cities, for example, a business executive was invited to speak to teachers on industry's use of computer programming. In Memphis, a professor from Rhodes College gave a presentation on discrete mathematics at the collaborative's kick-off dinner. Some collaboratives have arranged for teachers to visit businesses and industries. These site visits provide

teachers with resources for mathematical applications, but sometimes go beyond this to provide teachers with a feeling of being a part of a larger mathematics-using community. After a site-visit to Shell Offshore, a New Orleans teacher commented on the Shell Offshore staff, "They provided a more peer-type relationship rather than one that was superior."

It should also be noted that teachers at some sites are serving as resources to others in the community. The most vivid example of how teachers' expertise and experience can benefit those with whom they collaborate involves the Exploratorium in San Francisco. Teachers who worked closely with the Exploratorium staff during the Summer Institutes were asked to develop modules to explain the mathematics related to several exhibits. As a result, the exhibits became more of a guided learning experience rather than a simple exposure to physical phenomena.

The UMC project is striving to bring teachers and representatives of business and higher education together to improve and enhance both the professional lives of the teachers and mathematics education in the schools. The results of these efforts are beginning to emerge in several of the more established collaboratives, where representatives from all three sectors are working together to accomplish a common task or goal. In this interactive collaboration, teachers, business people, and university representatives share equal status, each contributing valuable viewpoints and expertise in order to solve a problem or to plan an activity. In Los Angeles, for example, teams are organized to plan and conduct workshops. One such team brought together an engineer from Hughes, an astrochemist from the California Institute of Technology, and a high school mathematics teacher to plan and present a workshop for teachers on exponential functions.

At this stage in the development of the project, it appears that collaboration assumes a variety of forms. Significant interaction among people has not occurred spontaneously; careful planning and program development have been prerequisites to collaborative success. Important relationships are forming among teachers--within schools, across schools, and even across sites. Relationships that involve teachers, business associates, and higher education representatives are more difficult to establish and require more time and effort. What has become clear at all eleven sites, however, is that representatives of the three sectors are becoming acquainted, teachers are becoming more knowledgeable about mathematics and its applications, and all are coming to understand their counterparts' working conditions. After a summer internship with a finance company, a Memphis teacher reported, "I learned that I could do something other than teach. It was a challenge. I learned that teachers are more confined, work harder, and aren't really treated as professionals." As the sites develop toward permanence, it will be important to note how these relationships evolve.

PROFESSIONALISM

A general picture is emerging of mathematics teachers in inner-city schools and how they view themselves as professionals. Since observations still are being made and convergent information is being sought, the picture is incomplete. Teacher interviews and questionnaire responses collected to date, however, provide an initial outline of teachers' perceptions of their profession and their own role in it.

Teachers in inner-city schools face limited budgets, a scarcity of resources, large classes, complex bureaucratic school systems, few opportunities for professional activities or enrichment, and high percentages of at-risk students. It appears that the collaboratives are beginning to provide these teachers with a sense of self-identification with a professional group that includes teachers, as well as mathematicians from businesses and universities. But the question remains about what impacts have been made or will be made on other aspects of the professional lives of teachers. Whether collaborative involvement will encourage teachers to assume the responsibility and demand the right to make significant decisions related to their work, and to the teaching profession in general, and whether teachers will develop a sense that they are providing a needed and valued service to society remains to be seen. The duration and design of the UMC project provides a rich opportunity for teachers to enhance their professional lives and for observers to note and to learn from the process.

The Documentation Project administered a survey on professionalism between May, 1986, and August, 1987, to teachers in nine of the eleven sites. The survey was a self-report of attitudes about teaching as a profession. Additional information about teachers' sense of professionalism was obtained through interviews; each month all eleven on-site observers queried five teachers to maintain a diary of professional relationships. Results of the survey suggest that teachers in nine of the sites believe that what they are doing is important to society. More teachers agreed than disagreed that others appreciate what they do. Teachers cited as reasons for their choice to teach mathematics both their liking of mathematics and their wish to work with youth; more teachers identified liking mathematics than their desire to work with young people.

Most mathematics teachers indicated that they feel comfortable talking with mathematicians from universities and businesses, and that they feel they have important contributions to make in such discussions. Only 13 percent of teachers reported feeling "out of place" in such conversations. Teachers also seem to feel that they have a lot to learn from one another. When interviewed about whether they would benefit most from meetings with other teachers or with other professionals from business or universities, more

than half of the teachers responded that they would gain the most from meetings with other high school mathematics teachers.

The mathematics teachers were more mixed in their responses when asked about making curriculum decisions. Not only did differences emerge among teachers at a given site, but clear differences in mean responses were identified across sites. The eleven sites vary a great deal in terms of who makes the decisions on curriculum. When teachers were interviewed about who made overall decisions about the objectives of mathematics courses, they gave a range of responses. Some reported that decisions were made by a district committee of teachers and the district mathematics supervisor. Others reported that teachers alone made the decisions. Still others indicated that the mathematics department, the district, the state, or textbook authors were responsible for curriculum decisions. Variation in the responses of teachers from a single site indicates that either curriculum decisions vary within a site or teachers have different perceptions about who is making decisions. When asked who should make these decisions, teachers most often agreed with the current practice as they perceived it. They were in strong agreement that teachers do and should make decisions on daily activities, lessons, and materials.

Results of both the survey and the personal interviews indicate that teachers do not agree that final decisions on curriculum should be theirs alone; in fact, more teachers indicated that the decision should not be their responsibility. This position supports the view that education falls within the domain of a number of different people, all of whom need to have input.

Teachers' perceptions about the level of control they exert vary across sites and do not always support that which local conditions would indicate. Durham teachers had a higher mean agreement with the statement that mathematics teachers have the control they should have and have an opportunity to exercise their own judgments. This is surprising in light of the control exerted by the state in selecting textbooks, defining salaries, and applying the Teacher Effectiveness Model. Teachers in Pittsburgh, on the other hand, varied in their responses and had one of the lowest mean agreements among the sites on questions related to autonomy in decision making. The school districts in both Pittsburgh and Durham are implementing a form of the Teacher Effectiveness Model. While in both sites, control of the teaching in classrooms is being imposed by a higher authority, teacher opinion noticeably differs between the sites.

Responses to questions about who should evaluate mathematics teachers also varied significantly across sites. Cleveland mathematics teachers had the highest mean agreement to the statement that mathematics teachers should be evaluated only by other mathematics teachers. In Cleveland, the task of evaluating teachers belongs to the principal, with apparently little input from teachers in the development of the evaluation procedures. Teachers from San Diego were split on the question of whether

mathematics teachers should be evaluated only by mathematics teachers. As in Cleveland, it appears that the principal evaluates teachers in San Diego. However, at least some of the teachers who were interviewed acknowledged that teachers had some input in the evaluation, either through contract negotiations or through submission of goals and objectives on which teachers were to be evaluated. Having some teachers input seems to defuse the need for teachers to be evaluated by other teachers.

Consistently across all nine sites, teachers who were identified as having a high level of collaborative participation responded more positively on the survey's professional organization scale than did other teachers. The collaboratives' active teachers also reported feeling more comfortable talking with university and business mathematicians, and more often expressed the view that professional organizations should have a role in reforms in school mathematics.

It appears that the collaboratives already are beginning to impact on the professionalism of teachers in the eleven targeted sites. Review of collaborative activities across sites reveals that the projects have generated a wide spectrum of professional activities unavailable prior to their existence. In St. Louis, where there are few incentives for engaging in professional activities and district mandates create a restrictive atmosphere, teachers who have been involved in the collaborative feel that their participation has given them the opportunity to be treated as professionals. In the Twin Cities, a Mathematics Society has been established. In Durham, the Triangle Mathematics Club offers teachers enrichment opportunities. In Los Angeles, +PLUS+ workshops bring teachers together to learn and to share. Some teachers are challenging traditions within their districts on such fundamental issues as who selects the textbook and who develops the schedule. These changes occur when individual teachers, motivated by both their involvement in the collaborative and the support they get from each other, take the initiative to challenge the status quo.

MATHEMATICS FOCUS

The eleven sites vary on the emphases they have given to specific mathematics topics. Where a group or person is available to provide clear leadership in a specific area of mathematics, the site has a more explicit definition of the mathematics it stresses and the direction it is taking to affect what mathematics students learn. In Cleveland, where the district mathematics supervisor is very involved with the collaborative, a clear focus on problem solving has emerged, with an emphasis on integrating problem solving into the mathematics curriculum. In Pittsburgh, where the district's associate director for mathematics is a member of the collaborative's decision-making group, the mathematics focus is an extension of district initiatives; these have included integrating

calculators and computers into the curriculum and encouraging teacher involvement in selecting the Algebra I textbook. In the Twin Cities, where there is strong involvement of university and college mathematicians in the governance of the collaborative, the focus is on problem solving; Summer Institutes are directed at helping teachers become better problem solvers.

Other collaboratives have depended heavily on teachers and teacher committees for input on the areas of mathematics that should be stressed in project activities. In these sites, the mathematics focus has included a variety of topics rather than centering on a specific theme. Durham, influenced by the teacher Steering Committee, has developed networks for teachers of algebra, precalculus, and geometry to provide an opportunity for colleagues teaching the same course to interact. In Los Angeles, department teachers have defined the direction to be taken by their group. Teams of teachers and business and university associates have planned workshops focusing on applications of mathematics and such topics as discrete mathematics.

Across sites, some general directions and issues are emerging as the collaboratives develop and work with the Technical Assistance Project. Equity in the classroom, an issue which involves differentiation in classes taken by particular groups of students, is clearly a concern at many sites. Problem solving has been, and will continue to be, an important mathematics focus across sites; in some instances, the collaborative has begun to influence the district curriculum and the ways in which teachers present mathematics as problem solving. A third issue focuses on technology in the classroom. In Philadelphia, for example, the collaborative is actively involved in working with teachers to help them use computers in the newly developed third-year mathematics course, Applications in Mathematics. All sites have included, to some extent, real-world applications of mathematics by inviting users of mathematics to make presentations or by including the issue as a key Summer Institute topic. In San Francisco, the Exploratorium worked with teachers to define the mathematics applicable to several exhibits. Another mathematics focus adopted by many of the sites involves the need for inclusion in the mathematics curriculum of more discrete mathematics, probability, and statistics. Many sites, such as St. Louis and Memphis, have invited speakers on discrete mathematics to address groups of teachers. A final mathematics focus of concern to a number of the sites involves increasing the effectiveness of efforts to make needed changes in the teaching of the traditional mathematics courses of Algebra and Geometry. Impetus for such improvements has resulted from increases in graduation requirements at many sites, including New Orleans, where students must complete Algebra 1, Geometry, and Algebra 2 for graduation.

The collaboratives have provided teachers with an impressive array of activities that have the potential of shaping the curriculum in ways identified by national organizations for reform of the mathematics curriculum. It is the role of the Technical

Assistance Project to apprise key people at each of the sites of the latest reforms. Collaborative teachers' increased awareness of current developments in mathematics education, locally and nationally, is a clear outcome of the UMC project. This new awareness has been developed through a variety of means, including workshops, institutes, newsletters, symposiums, and presentations. At this stage of project development, it is difficult to identify how teachers are responding to the many activities and whether their expanded awareness has impacted on the curriculum. Only a few of the sites have developed a clear vision and a definite strategy for taking advantage of teachers' increased knowledge of mathematics to affect the curriculum. In some collaborative sites, a weak link between the collaborative and the local school district makes it premature to even entertain such a vision.

Overall, a strong mathematics focus, which addresses issues of what it means to know mathematics and what mathematics should be included in the curriculum, has not evolved in the collaboratives. In most sites, collaborative efforts involving mathematics have been directed at creating topics for discussion or reasons for bringing people together rather than at creating a focus for curriculum change. Through project activities, however, teachers and others are becoming more aware of trends in mathematics education, needed change in emphases for the secondary mathematics curriculum, and applications of mathematics. But only the awareness stage has been reached, with most sites only on the edge of the current mathematics education reform movement. Some collaboratives have made more progress than others in assuming a strong mathematics focus. These are collaboratives that benefit from having someone with a strong mathematics background or interest in curriculum change who is actively involved in the collaborative. Collaboratives that are funded through a mathematics or mathematics education agency or that have the active involvement of the district mathematics supervisor generally have made more progress toward having a mathematics focus than the others.

True collaboration will result in teachers working with one another and with the larger mathematics education community toward lasting change in their own school systems and in the mathematics curriculum. Today, instances of collaborative impact are easily identified. At some sites, teachers are using the Geometric Supposer with skill and confidence, while at others, they are devoting new energy and effort to teaching their students problem solving. But significant change that raises the mathematical knowledge of large numbers of students to better prepare them to meet the challenges of the future will require true collaboration among teachers, district administrators, and other professional users of mathematics. The groundwork has been laid. The sites must now establish permanent structures that will wield a lasting influence on teachers, students, and the mathematics curriculum.

IV. FINAL COMMENTS

As the UMC project continues into its third year, a brief review of its progress reveals a series of significant successes that, taken together, form the foundation of a far-reaching network of new energy and enthusiasm for mathematics education in our nation's inner-city secondary schools.

Collaboration is catching. Participants in the Urban Mathematics Collaborative enterprise, from all sites and all supporting groups, have experienced a growing sense of community. Bureaucratic and institutionalized barriers are being removed. People are planning and working together. And things are happening. Through the energy and effort of individuals who are concerned and committed to education, changes are being made in the professional lives of teachers and in the educational experiences of their students. The project continues to be exciting, enriching, and challenging for the participating teachers, for the staff of each project, for the Technical Assistance Project, and for the staff of the Documentation Project.

Tensions in sites have existed as the collaboratives mature and gain strength through the relationships being formed. Collaboratives function within a context that is complex and influenced by many forces. Existing conditions, district policies, or state mandates are sometimes in direct conflict with the collaborative goals or operations. Progress is being made in removing some of these barriers by increasing the involvement of district administrators in collaborative planning or having the collaborative gain an identity as a force that can challenge existing practices. Having some district administration involvement, whether by a district mathematics supervisor or some other administrator, in collaborative decision making and planning helps to remove existing barriers between the collaborative and the district. When these people have not been as involved, problems have occurred.

The length and breadth of this report is testimony to the many activities that have been generated through the UMC project. In the more mature sites, a critical core of committed participants is forming and beginning to have an impact. At the newer sites, the collaboratives are gaining community recognition and making needed adjustments in their management and organizational structures. The Technical Assistance Project has fostered networking among the sites and has apprised the collaboratives of current developments and activities in mathematics education. A significant change in the past year involved the emergence of a national identity and a growing recognition of the UMC project's existence, efforts, and goals. People have begun to approach the TAP, the Documentation Project, and the Ford Foundation to work with or to become a part

of the project. Those interested in teacher renewal and curriculum reform are beginning to recognize the potential of the UMC project for creating positive changes in the mathematics education of the nation's inner-city youth.

Four general remarks should be made about the project as a whole, and about the process of documentation. First, the impact of a broadly based support network provided by the UMC project cannot be discounted in interpreting the development of the individual collaboratives. The Ford Foundation project monitor, Barbara Scott Nelson, and the staffs of the Technical Assistance Project and the Documentation Project have each contributed to and collaborated with all of the sites. The Ford Foundation's requirement that the collaboratives seek matching funds and become financially independent has provided an opportunity for the sites to evolve, to adjust as needed, and to initiate new activities; at the same time, it has encouraged them to look ahead, to develop community networks, and to concentrate on long-term planning. Dr. Nelson's ability to communicate with the sites and to foster their progress and development has provided encouragement and insight on a wide variety of occasions. As a representative of the prestigious Ford Foundation, Dr. Nelson offers the collaboratives public visibility and the political clout that can open school district doors or bring large numbers of new participants to a gathering or reception.

The Technical Assistance Project has sponsored activities for the collaboratives, has fostered networking among the sites, has convened meetings of key site representatives, has kept the sites informed of the status and direction of mathematics curriculum reform, and has acted behind the scenes to address problems at individual sites.

The Documentation Project provides each of the collaboratives with a broader view of its place in the overall UMC project. It offers an objective but attentive audience, with information and comments on how other sites are dealing with similar issues, and advice on problems common to all sites. The staff also provides professional expertise in mathematics education when such input is requested. In many sites, the on-site observer has assumed a leadership role that surpasses that of a reporter or recorder of events.

The eleven collaboratives do not operate in isolation, but depend on a support network that is both influential and valuable. In generalizing the concept of collaboration and in suggesting to other cities how they may develop their own collaboratives, the existence and role of the support network is a critical consideration. An important question is whether the existence of such a broadly based support network is essential to collaborative success.

A second issue that merits consideration involves change, reform, and the enhancement of the teaching profession. As we

document collaborative development and progress, with special attention to the process of change, it is essential to understand the social and political contexts in which each site operates, and the level of effective leadership available in each collaborative community. The impact of an individual school district, economy, community, funding agency or set of traditions on the nature and success of each site cannot be overestimated. As evidenced by the wide array of successful events and widespread progress described in this report, collaboration takes many forms; individual sites have managed to draw on the unique strengths and experiences of their own leadership to make change happen.

To date, that change has largely occurred at an individual level. As a result of their collaborative participation, a number of teachers at each site appear to view their profession differently. Certain teachers have changed the mathematics they teach and the methods they use. Others feel a part of a larger group of mathematicians. Some mathematics departments are now working as cohesive units rather than as individuals to achieve their goals. Nonetheless, change at a district-wide level is difficult to detect. It is possible that the collaboratives will affect most significantly the professional lives of individual teachers. It may be that two years is too short a time for system-wide changes to emerge. Or, it could be that significant change occurs in small increments that accumulate over time. The duration of the UMC project and the ongoing documentation of its development will provide insights into the process of change. The data and observations collected during the project's first two years form a rich base of information about the context, individuals, and activities of the collaboratives. As the more experienced sites begin addressing issues of permanence, this data base will enable us to detect changes in individuals, in the curriculum, and in the system.

A third topic of concern focuses on documentation and how our view of the process has changed since 1985. Initially, documentation was viewed as monitoring and reflecting on site developments. Data and information were collected as the basis of inferences about collaboration and its effect on the profes n of teaching. In the process of collecting information and writing reports, however, the Documentation Project's role has become increasingly interactive. Documenters on site visits frequently answer questions or clarify issues in discussions with teachers or collaborative staff. Simple objective documentation, without such interaction, runs the risk of neglecting a valuable opportunity to learn more about collaborative development and participants' views of it. As we interact with each site, it is essential that we achieve a balance between sharing information as a means of garnering sharper insights into the collaborative's problems and progress, on the one hand, and offering solutions and opinions based on our broader knowledge of the experiences of all eleven sites, on the other.

Interaction is of particular importance in writing the summary reports for each site. At times, we were short of information or made observations that conflicted with those of site participants. Reviewing the report with the project directors and coordinators fosters new insights, provides more extensive information, and sometimes enables the documenters to offer a different perspective to collaborative staff.

Key to the success of the documentation effort has been the work of the on-site observers. In seeking out people to interview, attending activities and meetings, and responding to our requests for information, the on-site observers provide an essential record of collaborative events and administrative processes. Isolated instances in which an on-site observer has been unable to serve this function highlighted the invaluable nature of this informational link between the collaborative sites and those responsible for charting their development.

During the documentation process, an effort is being made to gather information from as many sources as possible in order to achieve a broad perspective. The professionalism survey provides information about teachers as a group, while the teacher interviews conducted by the on-site observers help to validate the information from the survey and provide a more extensive explanation of survey results. The site visits offer the opportunity to talk with teachers and to probe particular issues, including how teachers view themselves as professionals. Individual case studies that will be conducted during 1988 will add to our pool of information by revealing the impact of the collaborative on individual teachers or specific events.

Finally, discussion of the impact of the UMC project must also include mention of the project's effect on the staff of the Documentation Project. After more than two years of observing the ways in which cooperative effort can produce unexpected successes, we have begun to incorporate the collaborative concept into other aspects of our professional lives. Just as vital to our own sense of professional enrichment has been the increasing respect and personal interest we have developed for each of the eleven collaboratives and the people who are working so hard to make them succeed. All of the documenters have taught and have been professionally committed to work in education for a number of years. But involvement in the UMC project has provided a new perspective on what it means to be a teacher in an inner-city school, and a new awareness of the number of very committed professionals who are teaching there. Many are working under less-than-desirable conditions--low pay, long hours, large absentee rates, students with a wide variety of social problems. And yet, when asked why they teach, these teachers inevitably respond that they like working with their students and would not want to do anything else. Asked why he was teaching, one teacher replied, "Nobody ever asked me that before. I guess it is because, while in school, the adults I most admired were my mathematics teachers."

Collaboration is working. The progress achieved since the project inception in 1985 suggests the possibilities; continued efforts and expanded networks in the months to come can be expected to further enhance the professional lives of inner-city mathematics teachers, to enrich the mathematics education of their students, and to provide a role model to other cities. The effects of the spirit of collaboration are extraordinary.

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APPENDIXES

SUMMARY REPORTS FOR THE ELEVEN URBAN MATHEMATICS COLLABORATIVES

AND FOR

THE TECHNICAL ASSISTANCE PROJECT

A. Cleveland Collaborative for Mathematics Education (CCME)
B. Durham Collaborative: The Durham Mathematics Council
C. Los Angeles Urban Mathematics/Science Collaborative (LAUM/MC)
D. Memphis Urban Mathematics Collaborative
E. New Orleans Mathematics Collaborative (NOMC)
F. Philadelphia Math Science Collaborative
G. Pittsburgh Mathematics Collaborative
H. St. Louis Urban Mathematics Collaborative
I. San Diego Urban Mathematics Collaborative
J. San Francisco Mathematics Collaborative
K. Twin Cities Urban Mathematics Collaborative
L. Technical Assistance Project (TAP)

The following reports are brief summaries of each of the eleven urban mathematics collaboratives funded by the Ford Foundation as well as of the Technical Assistance Project. Although the reports were prepared by staff of the Documentation Project, the content of each report was approved by the project.

SUMMARY REPORT:
CLEVELAND COLLABORATIVE FOR MATHEMATICS EDUCATION (C^2ME)

by

Urban Mathematics Collaborative Documentation Project
University of Wisconsin-Madison

PURPOSE OF THIS REPORT

This report summarizes the activities of the Cleveland Collaborative for Mathematics Education during the 1986-87 school year. The report is intended to be both factual and interpretive. The interpretations have been made in light of the long-term goal of the Ford Foundation to increase the professional status of mathematics teachers in urban school districts and the way in which the activities of the collaborative during the past year have evolved in order to reach that goal.

The information presented in this report came from the following sources: the proposal submitted by the Cleveland Collaborative to the Ford Foundation for the continued funding of the collaborative; documents provided by the project staff; monthly reports from the on-site observer; the meeting in San Francisco in October, 1986, of representatives of all of the projects; the directors' meeting held in St. Louis in January, 1987; meetings held during the annual NCTM conference in April, 1987, in Anaheim, California; survey data provided by teachers; and five site visits by the staff of the Documentation Project.

CLEVELAND COLLABORATIVE FOR MATHEMATICS EDUCATION (C^2ME)

A. Purpose

The purpose of the Cleveland Collaborative for Mathematics Education as stated in its proposal for continued funding is:

1. to provide professional enrichment opportunities for teachers;

2. to provide opportunities for teachers to increase their understanding of mathematics and its current applications; and

3. to facilitate sharing, communication, networking, and collegiality among teachers and mathematicians from business, industry, and higher education.

To accomplish these goals, C^2ME has developed a four-year work plan in cooperation with the Cleveland Public Schools and participating teachers. The plan specifies participants and outlines activities designed to enhance the collaborative's efforts to advance and reform the secondary school mathematics curriculum of the Cleveland Public Schools.

B. Context

Several factors impacted on the educational environment in which C^2ME operated during the 1986-87 school year. Four in particular affected collaborative development.

First, in June, 1986, Superintendent of Schools Ronald Boyd was asked to resign due to his lack of leadership in a tense and difficult political environment. In August, Alfred D. Tutela was named the new superintendent. Tutela had served as interim superintendent after the death of Fred Holiday in 1985. Mr. Tutela, who has a reputation for being bright and tough, has been in the school district for seven years.

Superintendent Tutela has exhibited support of the collaborative by attending one of its events. He acknowledged the dedication of those involved, and indicated that he was willing to listen to ideas and suggestions from C^2ME without conceding his full agreement on all points. Superintendent Tutela has been quick to articulate his initiatives and priorities, which include an early retirement buyout for 400 teachers, introduction of the "Scholarship in Escrow" program, and the need to repair buildings and plants.

The early buyout program for teacher retirement would open the door to employment of new teachers and, it is argued, would save money in the longer term. The Board of Education has approved 414 buyouts, representing the retirement of teachers with an accumulated 12,000 years of experience.

The Scholarship-in-Escrow program is a student incentive program supported by the school board. The cost of part of the superintendent's plan for the five-year program will be $2 million per year. Students in grades 7-12 will be paid for receiving good grades on their report cards: $40 for each A, $20 for each B, and $10 for each C. The money will be held in an accumulating fund to assist students in the payment of college fees. The program focuses on the student rather than on the teacher: if the student works harder, or better, the educational problem will be solved. While such a strategy may contribute to a solution, there is some concern that this approach overlooks the role of teachers. Additionally, teachers are concerned that paying for good grades will put pressure on teachers to inflate grades. The Scholarship-in-Escrow program is part of a comprehensive policy to deal with the high dropout rates in the district, currently 44 percent for white students, 38 percent for Hispanic students and 34 percent for black students. It is believed that local employment will shift, with mechanization replacing unskilled workers, so that by 1990, 75 percent of local jobs will require post high school training.

Many buildings are in poor repair due to age, faulty construction, and asbestos usage. Capital improvements to 135 facilities will cost $60 million over the next five years. The district budget faces a projected deficit due to cuts in both local property tax revenues and in state funding allocations. To offset this decline in income, Superintendent Tutela has proposed an operating levy of 8 mills, and a bond issue of $60 million. The levy, which has the strong support of the mayor, will be voted upon in August. The school board and the teachers' union support the levy and bond issue, as well as the capital improvements. The city council is divided on the issue.

Public reaction to Superintendent Tutela's performance has been positive; he has been credited with making progress with court-ordered desegregation, establishing a labor truce in the district, dealing effectively with the transportation problems which have accompanied busing, and having a stronger professional rapport with the school board than did several previous superintendents. A sampling of comments from school observers indicates that the district is much improved a year after Tutela was hired by a unanimous school board.

A second factor that impacted on the collaborative was the adoption of the middle school concept by the Cleveland Public Schools in September, 1986, which resulted in moving the ninth grade into the high school. Based on seniority, mathematics teachers were offered the opportunity to stay at the middle school or to move to the new high school program. As a result of this

upheaval, many mathematics teachers were teaching mathematics courses they had never taught or had not taught in many years. The need for teacher in-service became apparent.

Third, in May, 1986, it was announced that each of the twelve comprehensive high schools in Cleveland would participate in an effort to win a "Magnet School Assistance Grant" from the federal government. Each school could qualify to receive up to $20,000 for such purposes as teacher in-service, personnel costs, and teacher and student supplies. Grant requests were required to relate to specific themes that were developed by teacher teams at each high school, with at least one of the themes related to mathematics. Ultimately, the district's grant proposal was rejected by the federal government, but many positive activities occurred during the 1986-87 school year as a result of the competition.

Fourth, in December, 1986, the Cleveland Education Fund received a three-year grant from the Carnegie Corporation of New York to establish the Cleveland Science Collaborative. Joe Flynn was hired to be the full-time coordinator at the science collaborative.

The organization of the district itself has impacted on the collaborative's development, affecting its relationships with district personnel and with the staff in individual buildings. First, the district is largely decentralized, with expenditures controlled by principals. Curriculum supervisors submit suggested lists of equipment for purchase to principals but do so without budgets. Principals work within their individual budgets and establish their own priorities, with input from teams of teachers. Thus the collaborative must, to a large degree, depend on good will at the school building administrative level. If, for example, the collaborative were to produce sets of curriculum materials, the decision to purchase them would rest with school principals rather than with the central administration. Second, the union contract stipulates that teachers cannot be required to attend training sessions and must be paid for any sessions they choose to attend.

C. Development of the Collaborative

The proposal for refunding C^2ME, which was submitted in May, 1986, and funded as of September 1, 1986, reflected the initial success of the project's activities and the favorable response they received from teachers. The proposal discussed building upon these successful activities; no major restructuring or redirection of the project was proposed, nor did any seem warranted.

Paula C. Fay continues to direct the collaborative project. Harriet Jakob, the project coordinator, resigned in June, 1986, to attend medical school. She was temporarily replaced by Bryan Powers, who had taken early retirement from the district after having been a secondary science teacher consultant for several

years. In December, 1986, Suzanne Haggerty was hired to assume the coordinator's position. Ms. Haggerty is a senior at Oberlin College, with a major in mathematics and a minor in computer science. Robert Seitz, a mathematics teacher in the Cleveland High Schools, is the on-site observer and the editor of the collaborative newsletter.

During 1986, the U.S. Department of Defense and Aetna Insurance Foundation were identified as sources of collaborative support. In October, 1986, Aetna representatives joined the C²ME Advisory Board and awarded the collaborative a $22,000 grant. The Department of Defense committed itself in January, 1987, to helping the collaborative identify written mathematics resource materials. In addition, the DOD offered to arrange a visit to defense facilities for Cleveland mathematics teachers to receive training on the mathematics background needed by graduates in order to take advantage of military career opportunities.

Advisory Board

A thirty-two member Advisory Board oversees the operation of C²ME. Members of the Advisory Board include scientists; engineers; mathematicians; educators (secondary and post-secondary); and professionals in finance, accounting, and applied mathematics (product design and technological advancement). Seven Cleveland Public Schools mathematics teachers and the Cleveland Public Schools supervisor of mathematics also serve on the board. A local professional society (The Greater Cleveland Council of Teachers of Mathematics) and another educational project (EQUALS) also are represented. The flexibility of the board structure permits and encourages the addition of new members as needed; new members are accepted by the consensus of present members. All Advisory Board members serve three-year terms, and successive board or committee terms are allowed.

The Advisory Board met four times during the 1986-87 school year, in September, December, February and May. At the December meeting, four new members to the Advisory Board were welcomed. They included one member from the Department of Defense, two from Aetna Life Insurance, and a professor from Kent State University. In May, 1987, it was announced that the president of Richard Fleischman Architects had joined the Advisory Board.

Teacher Advisory Board (TAB)

A Teacher Advisory Board, composed of eleven teachers, was established in January, 1986, to discuss the needs and goals of Cleveland's secondary school mathematics teachers and to develop short- and long-range plans for C²ME activities. Members of the Teacher Advisory Board were selected by C²ME, in consultation with

the Cleveland Public Schools supervisor of mathematics, based on their pattern of participation in C²ME's programs and on their dedication to excellence in mathematics education in the Cleveland Public Schools. Richard Wittman, a mathematics teacher at an intermediate school, volunteered to act as spokesperson for the Teacher Advisory Board; he described the board as having some "real movers and shakers." The Teacher Advisory Board met once during the 1986-87 school year to discuss future activities of C²ME.

D. Relationship with Other Local Initiatives

In contrast to some of the other collaborative sites, there were very few projects in Cleveland for teachers when C²ME was funded in 1985. Thus, it had no competitors for teachers' time and attention. This situation, however, may change as a result of the establishment of the science collaborative.

Three proposals were funded during 1986-87 by the Ohio Board of Regents; when combined, these grants will provide more than $140,000 for programs geared to mathematics and science teachers. The proposals were written by other agencies to support the goals of the collaborative and will be funded directly through the college and university. The first proposal, submitted by Cuyahoga Community College, is directed towards both mathematics and science teachers.

The second proposal, submitted by Baldwin-Wallace College, is designed to provide help to underprepared seventh- and eighth-grade mathematics teachers in the areas of problem solving, technology and content. A retirement buyout, effective in June, 1987, coupled with a critical teacher shortage in mathematics nationwide, assures that most teachers of intermediate school mathematics in Cleveland public and private schools during the 1987-88 school year will be underprepared. These teachers will hold valid K-8 certificates, which require between zero and three lower-division college-level mathematics courses.

The third proposal, submitted by Cleveland State University, provides a $76,000 grant to support two three-week courses during the summer of 1987, one in algebra and one in analysis. Teachers will receive four graduate credit hours upon successful completion of this training. While the collaborative was a prime mover in planning the courses, only two of the forty teachers involved were from the Cleveland School District. Because the courses were scheduled during the summer, they were in direct competition with a number of collaborative activities.

Other professional development opportunities and incentives are offered to the Cleveland Public Schools mathematics teachers by local colleges. The collaborative has cooperated with Oberlin College to offer teachers workshops on problem solving, as well as other special programs. In addition, Oberlin Teachers Academy has

granted a set of full-tuition scholarships to mathematics teachers. Lorain County Community College conducted a four-seminar series in Advanced Technologies for mathematics teachers.

The Cleveland collaborative has served as a catalyst to teacher involvement in activities offered by other local agencies. For example, after the Teacher Advisory Board suggested a consumer mathematics course last year, the school district organized a committee of five teachers to work during the summer of 1986 to develop a curriculum that would replace shop mathematics and senior mathematics in the schools. The course emphasizes real-life applications and computer usage and will be taught in grades 10-12 with general mathematics as a prerequisite. The formation of this committee under the leadership of Bill Bauer, the district's mathematics supervisor, is an example of the interactive relationship between the collaborative and the school district. Furthermore, the collaborative has helped to identify materials for the new course, including a videotape series. Most of the tapes will be obtained from the Public Broadcasting System through a joint effort of the collaborative and the school system, but some local production also is planned. Curriculum development for the consumer mathematics course was aided substantially by the business and industry contacts established through the collaborative. C²ME also purchased a one-year newspaper subscription for all classes of consumer math.

The MathCounts contest, now in its fifth year, is another example of the collaborative's role as a catalyst. MathCounts, a combination coaching and competition program, is designed to address the problem of declining math skills among students at the precollege level. Students compete in both written and oral matches on such topics as probability and statistics, linear algebra, and polynomials. The program is funded in the State of Ohio by Standard Oil, and sponsored by NASA, NCTM, National Society of Professional Engineers, CNA Insurance Companies, and the U.S. Department of Education. Judges for the contest are supplied by John Carroll University and Baldwin-Wallace College. In 1986, the Cleveland School District had two teams entered with collaborative support. In 1987, the number of participating teams increased to fifteen.

The EQUALS program in Cleveland is offering a 30-hour in-service program aimed at attracting and retaining females and minorities in mathematics. EQUALS, which is affiliated with a national project, is locally sponsored by the Greater Cleveland Educational Center. It receives funding from a number of sources, including the Cleveland Foundation. In the collaborative budget, $1,000 was allocated to contribute to EQUALS' "Close The Lid Boxes" project, which is aimed at producing manipulative materials. To date, this money has not been used.

In November, Bill Bauer, the mathematics supervisor for the Cleveland School District; Bob Seitz, a high school mathematics teacher and the collaborative's on-site observer; and Dick Little,

the chair of the Advisory Board, attended a Yale conference on educational collaboratives. Fred M. Hechinger, the president of the New York Times Co. Foundation, was keynote speaker. The Yale-New Haven Collaborative, a Carnegie-funded science collaborative, was experiencing funding problems due to its lack of a strong link with industry. Many questions were directed at the representatives from Cleveland, as the Cleveland mathematics collaborative is viewed as being quite successful in this regard.

E. Project Activities

C^2ME's goal is to provide enrichment opportunities for teachers in industrial and university settings, to provide opportunities for teachers to engage in independent learning in advanced mathematics, to increase teachers' understanding of current applications of mathematics, to increase teacher collegiality and to eliminate barriers to professional collegiality, to offer opportunities to teachers for intellectual stimulation and renewal, and to provide teachers with opportunities to learn new approaches to mathematics instruction.

During summer 1986 and the 1986-87 school year, C^2ME offered a wide variety of in-school, out-of-school and networking activities for teachers. The Cleveland Education Fund also sponsored a series of luncheons for business leaders in the community, at which the collaborative's work was featured. A number of activities sponsored by other institutions also offered significant opportunities to area mathematics teachers. The collaborative supported these related activities by publicizing the events and in some cases, providing teachers funds to allow them to participate. These activities are described in this section. Activities directly sponsored by the collaborative are listed first, followed by activities for which the collaborative provided active support. In all cases, C^2ME served as a vital, proactive link between Cleveland mathematics teachers and a wide range of professional enrichment opportunities available to them.

Calculator Workshop

On September 13, an in-service workshop for intermediate mathematics teachers was held at the Hilton Inn. The workshop was designed to help teachers feel comfortable working with calculators and with integrating them into the curriculum; it was the first systematic calculator curriculum to be introduced in the Cleveland Public Schools. Fifty-one intermediate teachers attended. C^2ME plans to assist in developing, disseminating, and implementing new units and activities developed as a result of the in-service training. These calculator activities will be integrated into intermediate and high school courses. A make-up workshop for an

additional fifteen teachers who were unable to attend the initial workshop was held November 18.

The calculator project exemplifies C^2ME's creative funding techniques. The Cleveland Education Fund paid $5,000 for the calculator materials; the Cleveland Public Schools paid teachers for their attendance at the in-service training sessions; and the State of Ohio paid for three national trainers, a facility and refreshments.

GCCTM Display

The collaborative sponsored a display area at the fall meeting of the Greater Cleveland Council of Teachers of Mathematics (GCCTM). Staffed by secondary school mathematics teachers from Cleveland Public Schools, the display disseminated information and materials and promoted networking and collegiality in an effort to strengthen the link that exists between C^2ME and GCCTM.

Dinner Symposia

During the 1986-87 school year, the collaborative sponsored two Higher Education and Business/Industry Symposia. The symposia were designed to meet two primary goals: (1) to provide teachers with a forum for dialogue and interaction with their peers and with representatives of business, industry, public institutions, and higher education; and (2) to provide teachers with insights into current and future mathematical applications and topics.

Case-Western Reserve and IBM. On December 2, Case-Western Reserve University hosted and IBM sponsored an evening of mathematics for Cleveland mathematics teachers. Sixty-three mathematics teachers attended the symposium, along with thirteen members of the C^2ME advisory board. Dick Baznick (special assistant to the president) began the evening with a welcome to the teachers and a brief overview of the evening's activities; teachers then had the opportunity to attend one of three concurrent sessions. Their options included: 1) Mathematics in Business--A tour of a microcomputer laboratory at the Weatherhead School of Management, hosted by Dr. Miles Kennedy; 2) Artificial Intelligence and Robotics--A visit to the Center for Automation and Intelligent Systems Research; 3) Probabilities in Everyday Life--A visit with Dr. John McGervey, Professor of Physics at C.W.R.U. and author of a recently published book on this topic.

Following these sessions, teachers, university professors, business representatives, and members of the Advisory Board gathered for cocktails before dinner. After dinner, Dr. Philip J. Davis, professor of mathematics at Brown University, discussed "Napoleon's Theorem: The Importance of Geometry." Dr. Davis'

presentation emphasized the importance of the mathematics teacher as a motivator to students. The entire program was well received by the teachers.

National City Bank Operation Center. On May 6, 1987, a dinner symposium was held at National City Bank Operations Center. Thirty-nine teachers toured the Center and heard Dr. Kenneth Cummins of the Department of Mathematical Sciences, Kent State University, speak on "Helping to Motivate Students in the Study of Mathematics." Dr. Cummins suggested using physical materials or instruments to show mathematics at work, and using mathematical or arithmetical oddities, historical tidbits, and effective methodology and approaches in teaching. The teachers' evaluations indicated that they appreciated Dr. Cummins' presentation and enjoyed the tour of the National City Bank Operations Center and the discussion of the mathematics of banking.

Teachers were integrally involved in the planning of this activity. Two teacher-members of the Problem Solving Standing Committee toured the facility prior to the function. They spent time with the presenters, and reached an agreement on what content would be relevant for teachers to hear about while on the tour. These teachers also developed a packet of problems that was distributed to other teachers on the day of the visit.

One teacher commented, "Excellent! Dr. Cummins was great, really relevant material and motivational. Collaborative activities give a sense of worth to teachers." Another said, "[This was] one of the best presentations. It was down to earth... what I am preparing my kids for. Well designed and prepared." Although the teachers enjoyed the symposium and thought it was worthwhile, some felt that it was too long, particularly after a full day of teaching.

Superintendent of Schools Al Tutela attended the dinner symposium, the first C^2ME activity in which he participated. Tutela noted that the teachers' attendance at events such as the symposium indicated their dedication and their commitment to quality education in Cleveland.

The dinner symposia were among the most popular of C^2ME activities. Teacher evaluations suggested that a major factor in the symposia's success was that they provided an opportunity to "talk with colleagues." Other positive features listed included the tours, the exposure to the uses of mathematics in business and industry, and the distribution of free materials.

Algebra Competition

The First Annual C^2ME Algebra Competition was held at John Carroll University on May 16, 1987. The contest was designed to

promote mathematics through competitive events, and to help encourage teachers to cover the breadth of content specified by the curriculum. Twenty-seven teams from sixteen schools participated, for a total of 108 students and twenty coaches. Any student enrolled in Algebra I was eligible to compete. Students were enthusiastic, and both students and teachers enjoyed the event. Every participant received a ribbon and an "I Am a Mathemagician" t-shirt from the Aetna Foundation; certificates and refreshments were provided by John Carroll University. Teachers expressed their belief that competition in an academic event was very helpful in generating enthusiasm, and that visiting a college and hearing both the university president and the mathematics department chair speak to the students was beneficial. One university professor noted that: "The fact that we have gotten as many students as we have practicing and participating, and that teachers have given their time, shows that students are interested in mathematics." It is anticipated that next year, geometry and algebra contests will be held, with John Carroll University again acting as host.

Oberlin College Mayfair Festival

As part of Oberlin College's Mayfair Festival, C^2ME and Oberlin College jointly sponsored special activities for Cleveland Public School teachers on May 2, 1987. These activities, which were offered to teachers free of charge, included a tour of the Oberlin campus, a tour of the art museum with a view toward understanding the artist's mathematical problem-solving approach, a reception in the museum courtyard, a dinner, and attendance at the play, "The Miser," by Moliere. Due to conflicting activities, only five CPS math teachers and one CPS supervisor were able to attend the festival. All the teachers who attended felt that the event was very worthwhile. Also in attendance were the Chair of the Mathematics Department at Oberlin, Bob Young; Rudd Crawford; Dean Wolfe, Director of the Oberlin Teachers' Academy; Suzanne Haggerty, the C^2ME coordinator; and teachers' guests.

Retirement Dinner

On June 4, 1987, a dinner was held honoring eleven retiring mathematics teachers from the Cleveland Public Schools. It was planned and implemented by the Math Teachers Resource Center of C^2ME. Each retiree received a plaque and a small gift. The event was well received by the approximately thirty-five teachers who attended. One teacher noted that it was the first time in his memory that the mathematics department had been invited to this type of event and remarked that it was refreshing to honor people who have given many years of service to the school system. It was suggested that such an event be held every year.

Teacher Scholarships

As part of its commitment to C^2ME, the Department of Mathematics at John Carroll University continued to offer tuition scholarships to mathematics teachers in the Cleveland Public School System. These scholarships covered tuition for university mathematics courses, ranging from introductory calculus and statistics to graduate courses in the department's Master of Arts and Master of Science programs. Scholarships, awarded on a competitive basis by a department committee, were granted to two teachers during the 1986-87 school year. In the summer of 1987, one teacher received a full scholarship for 6 credits of work in the Master of Science Program.

The Martha Holden Jennings Foundation awarded a scholarship to a Cleveland Public Schools mathematics teacher to attend a one-week workshop on problem solving during the summer of 1986. The workshop was led by Dr. Johnny Hill of Miami University.

Project Advance

Project Advance was made possible by a grant from the Ohio Board of Regents. The project represented a joint effort of C^2ME, Cuyahoga Community College (CCC), Notre Dame College, John Carroll University, the Cleveland Public Schools, and TRW. The project provided an in-service experience for science and mathematics teachers, giving them new concepts and approaches for relating math and science teaching. The workshop was open to all area intermediate school mathematics and science teachers. Two CPS secondary mathematics teachers attended. The project was coordinated by CCC, instruction was provided by Notre Dame College, and two hours of graduate credit were provided through John Carroll University.

Teacher Internships

The Cleveland's Teacher Internship Program was established in 1980 to provide teachers with hands-on experience involving the mathematics used daily in business and industry. The program organizes summer work placements for teachers in area businesses or industrial labs for which teachers receive a stipend. In the summer of 1985, C^2ME coordinated ten placements in industry and, in a parallel effort, identified one person for an internship at Cleveland State University. In the summer of 1986, six teachers were placed in industry internships, and one was placed at Cleveland State University. While the original two-year internship plan anticipated a total of ten internships, C^2ME has generated eighteen internship placements during that period. (Prior to

C^2ME's efforts, only one Cleveland Public Schools mathematics teacher had been placed through CTIP.)

An internship generally lasts eight to ten weeks. In addition to working at the corporation, teachers attend five to seven Wednesday afternoon seminars during the summer and also prepare a new learning project for their own classrooms. Teacher interns enroll for one to seven graduate credits at CSU to earn credit for these projects. Interns meet in October to share their projects.

During the summer of 1986, those who were first-year interns received $500 per week, while those doing a second-year internship earned $550 per week. Third-year interns received $600 per week and fourth-year interns $650 per week. These amounts did not depend on grade level or subject matter. Many of the teachers participating in the 1986 programs had worked as interns in 1985. In questionnaires completed by five of seven teachers who participated in 1986, four of the five said they could integrate their work experience directly into their teaching or into the mathematics curriculum. All five of the teachers stated that they felt that curricular changes are needed if students are to meet the expectations of future employers.

Fifteen Cleveland Public School teachers have been selected by five corporations to serve as interns through Cleveland's Teacher Internship Program during summer, 1987. Of the fifteen, seven are mathematics teachers.

Cleveland Mathematics Teachers Resource Center

The Cleveland Mathematics Teachers Resource Center opened October 1, 1985, at the Metro Campus of Cuyahoga Community College. Three Cleveland Public Schools mathematics teachers were hired to establish and staff the Resource Center. Two of these three positions were restaffed at the beginning of the 1986-87 school year in order to provide several teachers an opportunity to work at the Center.

The Center provides Cleveland Public Schools mathematics teachers with opportunities for training, collegiality and information to enhance their knowledge and expertise as teachers. The Center also serves as the hub of curriculum development, in-service training, and collection and distribution of materials. It provides consultation services and distributes a list of suggested materials to each department chair in order to encourage mathematics departments to obtain supplemental textbooks, supplies, and materials such as calculators to help teachers implement an activities-based approach to mathematics instruction. In addition, the Center publishes a calendar of C^2ME activities and relevant information about other mathematics events sponsored by higher education, business, and industry, and distributes it to all secondary school mathematics teachers in the Cleveland Public

Schools. Packets of "teasers" and suggested classroom activities highlighting problem solving are compiled by Resource Center staff and distributed to teachers. During the 1986-87 school year, a computer, laser printer, modem and graphics software were purchased for the Center as part of a grant from Aetna Life and Casualty Foundation. This enabled the Center to produce its calendar and other flyers in-house.

Throughout the 1986-87 school year, the Resource Center offered informative programs and workshops; it was also the site of a variety of meetings, including those of the Test Construction and Textbook Selection Committees, and School Mathematics Department meetings. The Center is closed during the summer.

Between October 1, 1985, when the Center first opened, and December, 1985, eighty-five teachers took advantage of its resources. During the same months in 1986, the number of visits to the Center increased to 243, and by the end of June, 1987, the number of visits had increased to 473. Nearly all of these visits were made by teachers. This clearly demonstrates that Cleveland teachers recognize the importance of the services the Resource Center provides.

C^2ME Newsletter

During the 1986-87 school year, the collaborative quarterly newsletter continued to be distributed to teachers and to Advisory Board members. Three hundred copies of the spring newsletter also were distributed to Cleveland area businesses. The newsletter includes articles on C^2ME's goals, descriptions of programs and offerings to teachers, and recognition of teachers for both their personal accomplishments and their participation in C^2ME activities. Bob Seitz, a Cleveland Public School mathematics teacher and the collaborative on-site observer, edits the newsletter.

Seminar in Advanced Technologies at Lorain County Community College

The fourth seminar series in advanced technologies at Lorain County Community College was held April 21-24, 1987. (The first three seminar series were held in April and June, 1985, and in April, 1986.) The five-day program was designed to broaden the experience of selected high school mathematics teachers by enabling them to participate in an optional introductory session on the IBM PC, followed by a series of four 4-hour advanced technology workshops in the areas of computer-aided graphics and design, computer numerical control of machinery, robotics, and statistical control of processes and quality. Instructors presented the basic concepts of new technologies and highlighted the integral part that

mathematics plays in each. Teachers devoted afternoons to small-group work on lesson planning, so that at the conclusion of the course participants were able to formulate and present plans for further study in the technical area of their choice. In addition to tuition grants and lunch allowances, teachers received $100 stipends.

Five Cleveland mathematics teachers participated in the workshop. Teacher evaluations were extremely positive. The quality of content and instruction for each of the sessions was judged "very good" to "excellent" by all participants. In general, most teachers thought that the program was applicable to the high school classroom and was useful in improving their teaching. One teacher noted that "the information and illustration along with classroom teaching, would provide students with a quality education." Another wrote, "Good examples of industry to take back to the classroom. A very informative workshop." A third teacher mentioned that although "it was not pertinent to math teachers, . . . we in the Cleveland system need to infuse the idea of employability skills for students so the ideas were good."

Oberlin Problem-Solving Workshop

Six secondary school mathematics teachers received collaborative funding to attend a workshop in problem solving at the Oberlin Teachers Academy from June 16 to June 28, 1986. The workshop was designed to sharpen teachers' skills, to help them build a problem-solving library, and to guide them in preparing a plan for classroom implementation. The seminars were taught by Dr. Rudd Crawford, a mathematics teacher at Oberlin High School and the director of the STELLA project in problem solving--a project for which he has received national recognition. Dr. Crawford is also half-time instructor at Oberlin College.

All of the participants felt the workshop was worthwhile and said they would apply what they had learned in their classrooms in the fall. The teachers also stressed the value of meeting and working with other mathematicians. One teacher said, "The activity was excellent; I would advise it for everyone. It should be mandatory for teachers who have not been in class for awhile." Other comments included: "I would like to see every Cleveland teacher exposed to this activity. I received an organizational framework for giving non-routine problems in a systematic fashion"; "The experience is a rich resource for future planning in the teaching of mathematics, for networking with other math teachers in the Cleveland Area and for future professional growth"; and "I think that the two-week workshop has been very helpful to me. It gives me something concrete to take back and try in the classroom. Our own problem-solving skills were increased also. The workshop really motivated me to do more with problem solving."

The collaborative paid the six teachers who attended the Oberlin workshop to spend two weeks organizing and further developing the problem-solving materials, and to plan two one-day workshops in August on problem solving for Cleveland mathematics teachers.

At a meeting of the Advisory Board in February, 1987, Rudd Crawford described the great enthusiasm of the Cleveland teachers who had attended the Teachers Academy. He credited them as the driving force behind dissemination of the problem-solving materials.

Problem-Solving In-service for Intermediate and High School Teachers

The summer Oberlin problem-solving workshops were so well received that the district decided to follow up with two, one-day in-service programs for all Cleveland Public School teachers in grades 7-12; the programs were initiated by the teachers who had gone to Oberlin. Bill Bauer, working with teachers and university professors, developed the details for the district-wide in-service. A total of 137 of the 186 eligible mathematics teachers attended one of the two days. On August 25, fifty-eight seventh- and eighth-grade mathematics teachers, approximately 75% of those in the district, attended the workshop. On August 27, seventy-nine high school mathematics teachers, approximately 60% of those in the district, attended.

The workshops' main purposes were to promote problem solving, to foster collegiality among teachers, and to increase teacher awareness of programs and opportunities available to them. At each of the in-service sessions, Rudd Crawford of Oberlin College explained his problem-solving techniques and gave each teacher a box of fifty-one problems that were prepared by teachers who had attended the two-week workshop held at Oberlin in June. Teachers also received other curriculum materials, applications to join professional organizations, and a summary of anticipated developments in the Cleveland schools in the near future. An overview of the collaborative and the activities it sponsors also was presented.

The teachers seemed quite impressed with the workshop. Many commented that it was the first time in many years that the district had paid attention to mathematics teachers, had given them a "big picture" of the curriculum, or suggested specific equipment or materials. Most of the evaluations were very good, with many teachers expressing an interest in more workshops. Comments included: "The session was very impressive, real needs were systematically satisfied. Materials are very useful and could only be acquired personally with many hours of effort. Congratulations"; "Forces me to do what I should do. Certainly worthwhile"; and "I liked receiving immediately usable materials, a

lot of structure for the year. Very good kickoff for the new school year."

A make-up problem-solving in-service was offered on October 9 to those teachers who were unable to attend the original in-service. Sixteen teachers attended.

The district will fund another session of the problem-solving workshop during the summer of 1987.

Problem-Solving Weekend Seminar Series

Six weekend seminars similar to the Problem-Solving Summer Workshop were scheduled at Oberlin College during the 1986-87 school year. Sessions were offered October 3 and 4; October 31 and November 1; November 21 and 22; March 6 and 7; March 13 and 14; and May 8 and 9. Each session included a Friday dinner meeting, night lectures, and a Saturday breakfast meeting with further sessions lasting into the afternoon. Fifteen collaborative teachers attended the first session, eleven attended the second and five attended the third. The remaining places were filled by teachers from neighboring districts. The reduction in teacher participation during the spring semester can be interpreted as a reflection of the need to refocus this type of activity. By the end of 1986, one quarter of the target population had taken part in the summer workshop or weekend seminars.

Participants in the first workshop felt it was worthwhile, although some believed there was too much to do in the short time allotted. One teacher commented: "It was an opportunity to exchange ideas with other mathematics teachers. It was refreshing without being pressured on deadlines." Another observed: "The concept is worthwhile--developing a long-term project that people need help in. . . . I was rushed, should be longer than one weekend. . . . I expected more on 'techniques' of teaching problem solving!" After the second workshop, a teacher commented: ". . . I loved it because we worked together with other math teachers, had a nice time, did real mathematics. . . . Teachers were confident, a step ahead because of our August workshop."

Mixing with colleagues from outside the local system appeared to add an important dimension to the activity. Teachers selected to participate in the sessions wrote problems that were added to the bank of problems that had been distributed at the August workshop.

As a result of the enthusiasm generated by these sessions, a Problem Solving Standing Committee of Cleveland teachers was formed to collect data about the use of the problems and to develop and distribute additional problems. A survey of teachers was conducted to determine what needs were not being met.

Baldwin Wallace Workshop

In October, thirteen intermediate school teachers were selected to attend workshops on the implementation of student-centered activities. The workshops, which were offered every Wednesday for ten sessions through the months of October, November and December, covered topics related to the incorporation of MathCounts into the curriculum. Dr. Richard Little, who is a professor of mathematics and computer science at Baldwin-Wallace College, a judge in the MathCounts contest, and chairman of the C²ME Advisory Board, planned the workshops in consultation with the Cleveland Public Schools supervisor of mathematics. Six teachers earned three hours of college credit for their participation.

Conference on Computers in Secondary School Mathematics

Two teachers from the collaborative were selected to attend a six-day conference on computers and secondary school mathematics. The conference, held at Phillips Exeter Academy in New Hampshire in June, 1986, focused on the impact and application of the computer on the curriculum. Funding for the teachers was provided by the Technical Assistance Project at the Education Development Center, Inc. After returning from the conference, one of the teachers held workshops for colleagues at the Mathematics Teachers resource center on the use of a program he wrote to replace the grade book. The other teacher works in the district's Computer Center, and has continued offering workshops involving issues and content relevant to the Exeter meeting. The teachers were also involved in curriculum development with other teachers and the Cleveland Public Schools supervisor of mathematics; however, the extent of the follow-up was limited by the fact that much of the software distributed at Exeter was not compatible with the computers that are used in the Cleveland Public Schools.

In June, 1987, a teacher from the collaborative attended the 1987 Conference on Secondary School Mathematics and Computers at Phillips Exeter Academy. The conference focused on providing exposure to new concepts in integrating computer technology into the existing curriculum. The teacher's trip was funded by the UMC Technical Assistance Project at EDC, Education Development Center, Inc.

Small Grants Program

C²ME has made a concerted effort to encourage teachers to apply for small grants. Two informational meetings for mathematics teachers were held to explain the "research and test" philosophy of the small grants program, and the Small Grants Booklet was distributed to all mathematics teachers in September, 1986. This

booklet lists the names, telephone numbers, and project descriptions of teachers who have received small grants. A typical small grant award averages $440.

During the last three years, small grants totaling more than $10,000 made available by General Electric were awarded to mathematics teachers to fund mathematics pilot projects; eight grants were made to secondary school mathematics teachers during 1984-85, seven during 1985-86, and ten totaling $4,602 during 1986-87. Prior to C^2ME's involvement, only one small grant had been awarded to a Cleveland Public School mathematics teacher. Some teachers who received small grants had prepared and submitted projects as a result of their experience in the advanced technology seminars at Lorain County Community College.

The small grants program, in general, was well received by teachers. One teacher commented: "The small grants program allowed me to give my students the WHY of learning mathematics."

Professional Meetings

C^2ME is committed to increasing the attendance of Cleveland Public School secondary mathematics teachers at professional meetings, as traditionally low attendance is considered an impediment to the professional renewal of teachers.

The collaborative sponsored and paid travel and lodging expenses for ten mathematics teachers to attend the annual meeting of the Ohio Council of Teachers of Mathematics in Cincinnati in March. The collaborative arranged funding for Bill Bauer to attend the annual meeting of the National Conference of Supervisors of Mathematics annual meeting in California in April, 1987. It also identified funds so that Bill Bauer, Dick Little (Chair of Mathematics and Computing Department of Baldwin Wallace College, and the C^2ME Advisory Board chair in 1986-87), and Rudd Crawford could attend the Harvard Regional Mathematics Network information session. These three heard about what Harvard was producing. The information they received was helpful in writing a proposal to NSF for money to finance the Problem Solving Infusion Project which is described in the Next Steps section.

Community Leaders Luncheon

Four times a year, the Cleveland Education Fund sponsors a luncheon and afternoon meeting for community leaders. One purpose for these meetings is to keep these people informed of what is happening with the Fund's projects. The luncheon is attended by the Chief Executive Officers of area corporations or their representatives, people from universities, and representatives from key community organizations.

F. Observations

The Cleveland Collaborative for Mathematics Education has continued to progress during the 1986-87 school year. Discussion of the collaborative's growth will focus on four major issues: Project Management, Collaboration, Teacher Professionalism, and Mathematics Focus.

PROJECT MANAGEMENT

Management of the project remained in the capable hands of Paula C. Fay. In spite of the turnover in coordinators each year, the project has continued to progress and to offer a rich and varied array of activities that have been well received by teachers. Three characteristics of the Cleveland collaborative seem to have allowed such steady progress, even in the face of major personnel changes: (1) the professional strength of the director, and her solid and enduring leadership; (2) the cooperative relationship between the collaborative and the supervisor of mathematics from the Cleveland Public Schools; and (3) the high priority placed on teacher involvement very early in the collaborative's development, so that a strong core of teachers have emerged who participate frequently in collaborative activities. Together, the director, the mathematics supervisor and the teachers have maintained a strong vision that provides continuity.

The Cleveland Collaborative for Mathematics Education has achieved a level of success that has drawn national attention. The Cleveland Foundation used the CCME as one of the featured segments at its annual meeting. The author of a forthcoming book under the auspices of the Carnegie Foundation visited the collaborative to seek information on the topic of "teacher empowerment."

There is some question, however, as to the degree of teacher involvement in the collaborative's decision-making process, or, at least, in teachers' awareness of the opportunities for this type of involvement. The seven teachers who serve on the Collaborative's Advisory Board do provide some teacher input. The Teacher Advisory Board can also provide an opportunity to garner additional teacher feedback. Since the Teacher Advisory Board met only once during the year, however, in actuality it has not been very active in decision making. Some teachers have commented that collaborative decisions seem to be made by the Cleveland Education Fund. It appears that more teacher involvement in decision making is warranted, or that more teachers need to be made aware of their peers' involvement. Teachers need to know that their coworkers are actively participating in the collaborative's management and decision-making procedures.

While some teachers perceive that the collaborative is an externally provided resource base, other teachers are highly involved. These mathematics teachers have conducted workshops through the Resource Center, worked on a display for the Greater Cleveland Council of Teachers of Mathematics fall meeting, and planned the retirement dinner. The variation of involvement of teachers is an indication of growth. While there are teachers who have been engaged in planning and presenting activities, other teachers are primarily clients or receivers of services provided by other teachers and by those from the other two sectors.

The Teacher Resource Center provides a centerpoint for observing both the positive thrust of the collaborative, and the effect of the relative isolation of the various interest groups involved. Formally staffed for three hours every afternoon from Monday to Thursday, the center is used regularly by individual teachers as well as by school and district committees. In part this high level of use is due to type and quality of materials the center contains; just as important is the fact that the center is open at a time when janitorial contracts make it expensive or otherwise difficult to meet in school buildings. The center also represents a neutral ground. The center serves a dual function: it is a materials and meeting resource for teachers, and a printshop for the collaborative. While it is appropriate that the center fills both of these rather complementary roles, the situation does create a degree of competition among users for the center staff's time.

While these observations embody an evaluation of the center and its role, it should be remembered that the center represents one of the collaborative's real success stories in that it has brought some real changes to the lives of a number of teachers who are working in a district that suffers from profound financial and material problems. It would be an error to focus on the issues of concern without placing them in the overall context of a vital, successful project.

COLLABORATION

The collaborative aspects of C^2ME have expanded during the past year. Strong support from business and industry, first demonstrated when the collaborative was initiated, has not diminished. Cooperation from higher education, initially lacking, is now beginning to emerge. Most important has been the evolution of a strong core of mathematics teachers with the potential to exert influence on the scope and direction of C^2ME. This potential is starting to be realized through the teacher representatives on the Advisory Board, a trend that is being encouraged and facilitated by the efforts of the district mathematics supervisor. In one of the most interesting developments to date, teachers have drawn on considerable input from university and industrial mathematicians to create curriculum materials for their own use. For

example, the development of problem-solving activity kits was supervised and assisted by Rudd Crawford from Oberlin. The involvement of members of the Advisory Board in supplying material for a consumer mathematics course to replace Shop Math further demonstrates the potential benefits of building collaborative relationships.

In the beginning of C^2ME, the collaboration consisted mainly of business and university sectors supporting teachers rather than interacting with them. Some teachers, therefore, perceived that collaborative activities were being organized for them, rather than by them. The collaborative was seen as a source of resources rather than as a cross sector interface. As the collaborative developed, teachers have been able to network among themselves, an opportunity which is of great value. The broader interaction with other mathematicians in business, industry and higher education is also evolving. This is essential if political support is to be established for enhancement of the profession of teaching. Examples of activity planning now occurring in the Cleveland project illustrate the growth of this kind of interaction between groups.

The algebra contest was an example of a collaborative effort among the various sectors; it was a very positive experience which significantly involved teachers, university mathematicians, business people, parents, and students. A committee of four university mathematicians and two public school teachers met several times, beginning in January, to identify appropriate items to establish the format. The university mathematicians and teachers conducted the contest. The teachers coached their students. Aetna and John Carroll University funded the event, with Aetna providing 1,000 silk-screened t-shirts. The students trained and participated in the contest, while parents saw to it that students had transportation to and from the event.

In the future, perhaps, the contest will be viewed as an opportunity for more teachers and university mathematicians to work closely together for the benefit of all involved. The challenge to C^2ME is to determine ways for more teachers to experience the collegiality that is developed through working together for a common goal. Through such interaction, university professors can come to know more about the teaching of algebra in the high school classroom, and more teachers can gain a greater understanding of what universities expect students to know about algebra.

An important and interesting component of the activities of C^2ME involves the attention the project pays to its business sector. Two activities are cases in point: First, the Cleveland Education Fund sponsors luncheon meetings at the Union Club for business leaders at which C^2ME activities are noted. Second, the collaborative mailed 300 copies of the April 1987 C^2ME newsletter to area businesses. The business community has exhibited strong support for the collaborative, as well as a willingness to provide financial support. For example, Holcolm donated a $360 desktop

publishing workshop for the Teacher Resource Center, and the Aetna Foundation awarded the project a grant of $22,000.

Long-term school-district support for the activities of C^2ME is problematic, given the history and volatile nature of the politics and relationships between the School Board and the administration. However, there seems to be a feeling that the new superintendent is at least sympathetic to the collaborative; whether this support stems from his perception of the project as a source of additional resources at a time of great shortage is a moot point. The collaborative, by virtue of the linkages it has strengthened among teachers, has a potential for transforming relations between teachers and their employers.

Bill Bauer's strong support for the collaborative was acknowledged in a letter to Superintendent Tutela from the Chair of the Board of Trustees of the Cleveland Education Fund. Mr. Bill Madar wrote: "With Bill Bauer's support the mathematics teachers have truly taken ownership of the activities of C^2ME. Their increased participation, leadership, energy and enthusiasm have not gone unnoticed by The Ford Foundation or by other cities. Cleveland's C^2ME has become a model of success."

TEACHER PROFESSIONALISM

Activities sponsored or supported by C^2ME have been rich and varied, and they have provided all teachers in the district opportunities for professional development. A very active core group of teachers has organized, developed, and participated in many of the activities. This enthusiastic core is expanding, and the conviction and work of its members are beginning to overcome the hesitation of their peers.

The pay scales in Cleveland are now quite high, and teachers are reasonably well buffered from the bulk of school board politics. While teachers are prepared to engage in professional activities on their own time, it has been difficult to attract them to after-school sessions without payment. Some teachers hold second jobs, from teaching a graduate course at a local college to working for a department store on weekends. In spite of these commitments, however, the participation rate of teachers in collaborative programs has been extraordinarily high. In 1986, 54% of teachers attended at least one collaborative activity. In an address to area businessmen, Bill Madar suggested that this was a level of voluntary participation that any corporation would be pleased to achieve! By May, 1987, 81% of the teachers had participated in at least one activity, 62% had attended two or more activities, 43% had attended three or more, 28% had attended four or more, and 17% had attended at least five. There are twenty-three schools at which all the teachers have attended at least one collaborative function. By August, 1987, 83% of the total 186 teachers had participated in at least one activity.

Analysis also indicates that the number of teachers who have participated in two or more activities has doubled when compared to the prior 18-month period. Participation in three or more activities has increased two and one-half times, and participation in at least four activities has tripled. Participation in at least five activities has increased from 10 percent to 27 percent, representing a core group of forty-six teachers.

For teachers who have not become involved, however, a "working-place mentality" still exists, as exhibited by their comments at the August problem-solving workshop. Most initial questions addressed such topics as who was paying for parking and lunch. These teachers are accustomed to being treated as conduits in a system, as workers on an assembly line, and they expect to be regarded as such. For some, demands for more money become a way to strike back at a system that has treated them unprofessionally.

In Cleveland, teachers are working within a framework in which the state formally approves curricula; this tends to be taken as virtually automatic. The supervisor of mathematics has encouraged teacher involvement in text selection, and the writing of the district-wide midyear and end-of-year tests.

Teachers were selected by math supervisor Bill Bauer to write midterm and final exams for all of the secondary mathematics courses (Consumer Math, General Math, Introductory Algebra I and II, Algebra I, Geometry, Algebra-Trigonometry, Advanced Math, and Calculus). A team of twenty-three teachers revised the pupil performance objectives and developed midterm examinations that were administered in each district school in January. The committee then worked during the spring to develop final exams, which were administered at the end of the school year. Reaction to the tests was very favorable.

In addition, during the 1986-87 school year, more than 100 teachers were involved in pilot testing new mathematics textbooks. Textbook committees composed of these teachers are currently selecting books to be purchased for the various courses. These processes have allowed teachers to provide input into the mathematics curriculum and to feel ownership of the mathematics program. This feeling was expressed by the on-site observer when he said, "The collaborative has succeeded in giving the teachers a voice in the decision-making process and giving us the recognition we deserve."

The mathematics supervisor also has actively supported teachers seeking to attend professional conferences. The collaborative has successfully provided a context within which the district has allowed some teachers to attend the local annual meeting of NCTM.

There is no question that the core group of teachers who have actively participated in CAME during the past two years have gained a real sense of professionalism. These teachers are receiving

recognition and assuming responsibilities that they have never before experienced. For example, Bob Seitz, an active teacher member of the collaborative and the on-site observer for the Documentation Project, is a nominee for a Presidential Award for Excellence in Teaching Mathematics. Furthermore, Mr. Seitz's Academic Decathlon Team defeated five other teams (including four from the suburbs) in the Ohio Academic Decathlon. His Academic Challenge Team was presented to the Board of Education and praised for its success in the televised competition. Mr. Seitz was asked to address the 900 people who attended the Academic Decathlon Banquet.

It appears that teachers are not the only participants who have been empowered as a result of the collaborative; the position of the school district's mathematics supervisor has been strengthened substantially through his association with the collaborative and as a result of its legitimacy in the community and school district. In addition, the mathematics supervisor has discovered new ways of involving teachers, has realized the value of that involvement, and has developed creative ways of using in-service funds to enhance the professionalism of teachers.

MATHEMATICS FOCUS

The Cleveland Collaborative focuses on mathematics education, rather than on mathematics as such. The textbook committees organized by the mathematics supervisor, the grant application to the National Science Foundation, operation of the Teacher Resource Center, and support of attendance at local NCTM meetings and at the Phillips Exeter conference provide teachers with opportunities to develop pedagogical skills, to influence curricular content (albeit within the constraints of publishers and the state curriculum), and to develop classroom materials.

Within this more general orientation, the project's specific foci relate to problem solving in mathematics classrooms and the use of calculators as classroom tools and as teaching aids.

G. Next Steps

The collaborative recognizes that it must have vision in order to make a lasting impression. This vision would dictate the following:

1. The programs must form a coherent whole, building upon one another to address identified needs. For example, the Ohio State Pre-Algebra Demonstration Project will build on the skills and knowledge developed in the current calculator project.

2. Careful consideration must be given to continued financial support. Creative fundraising is the key. The collaborative will continue to look for ways to tap existing local, state, federal, and national funding.

3. Teacher support must be maintained and increased. A danger exists that teachers' energies will be spread so thin that programs will become ineffectual, and sufficient follow-up will not occur. Symposia must remain novel and stimulating, workshops must be highly applicable to the classroom, support must be forthcoming. The core group of teachers must be strengthened and expanded so that it becomes the teachers who are motivating the improvement. Strengthening the network between teachers will be a major step toward this end.

Several steps were initiated to encourage communication among teachers. First, C²ME is creating the "Schoolhouse" on Free-Net, which is a free community-access bulletin board based on a representation of an entire electronic city. The "Schoolhouse" will include an information desk, school bulletin board, teacher's lounge, library, counselor's office, mathematics center, and C²ME room. This facility will enable instantaneous communication between teachers in locations across the city. Modems have already been distributed to several high schools. Communication among teachers has been facilitated this past year by improving the in-house printing capability of the Math Teachers Resource Center by the addition of a laser printer and software. Calendars are being produced less expensively and more quickly. Flyers are being readily produced to announce changes and new activities, and to serve as reminders. In all of these efforts, teachers are working for teachers, so that power springs from within.

Several collaborative efforts directed at meeting these goals are now in the planning stages.

NSF Proposal

The Cleveland Collaborative for Mathematics Education is currently in the process of submitting a four-year NSF grant to enhance the teaching of problem solving at the seventh, eighth, and ninth grade level. The proposal has basic components: 1) Curriculum development, 2) Staff development, 3) Dissemination, and 4) Evaluation.

Unique aspects of the program include the use of the Free-Net bulletin board at Case-Western University to share problems with teachers throughout the district and suburban schools. In addition, a series of notebooks containing worksheets, problems and transparencies will be developed.

Mathematics and Technology Human Resources Enrichment Project (MATH REP)

The Ohio Board of Regents made a grant of $41,000 for a partnership project of CCME, Baldwin-Wallace and Cleveland Public Schools. The project, entitled the Mathematics and Technology Human Resources Enrichment Project (MATH REP), will begin June 16, 1987, with a three-week workshop. MATH REP addresses the underpreparedness of mathematics teachers in the intermediate schools. During the MATH REP summer program the ten guest speakers will include Ohio recipients of the Presidential Award for Excellence in Teaching Mathematics, text authors, and an IBM education specialist. Director Little will teach one session each day on geometry and problem solving, and associate director Bauer will teach one session each day on number theory, calculators and classroom procedures. These class sessions will be one hour and 45 minutes each. The participants will attend the Paul Klee exhibit at the Cleveland Museum of Art. Klee has taught mathematics at the Bauhaus and has used geometry extensively in many of his paintings and sketches. Tours of NASA Lewis Research Center Museum and the computer center of Cedar Point Amusement Park will also be part of the program.

NCSSM Workshop

The Mathematics Department at North Carolina School of Science and Mathematics (NCSSM), working with a grant from the Carnegie Corporation of New York, is developing a syllabus for fourth-year college preparatory mathematics. The syllabus is being seen as the future trend in mathematics education. NSF has funded a project to train teachers in the use of the syllabus. This project matches the objectives of the collaborative. First, it provides teachers with staff development activities in the future trends of mathematics. Specifically, teachers will become familiar with recommendations about the secondary mathematics curriculum from NCTM, MAA (Mathematics Association of America), CUPM (Committee on the Undergraduate Program in Mathematics for MAA), NSF, and the Department of Education. Second, and most important, it provides a model of teacher training in which teachers take a leadership role. It is a model of empowering teachers within their profession, giving them greater involvement in mathematics education. Three teachers from CPS School of Science will attend a training session in North Carolina from July 5-July 17, 1987. These teachers will pilot the materials during the 1987-88 school year and conduct a five-day workshop for CPS teachers during the summer of 1988.

Preparation for College Mathematics

C^2ME and the Cleveland [illegible]hools will be working with Ohio State University on four separate projects next year. Those are:

1) Approaching Algebra Numerically (AAN) - This program, recently funded with a $44,000 grant from the Ohio Board of Regents, focuses on instruction in seventh and eighth grade using scientific calculators. Fifteen CPS teachers will attend two days of instruction split between mathematics content and pedagogy. The first session will provide an overview of the materials to be piloted and an introduction to techniques of using the calculator with children in the intermediate schools. The second session will examine the table-building, guess-and-check problem solving process. The instructors are Alan Osborne and Franklin Demana of Ohio State University.

2) NSF-funded Squeeze Play Project - This project for teachers in the ninth, tenth and eleventh grades, is designed to build on the Approaching Algebra Numerically (AAN) by using graphing calculators and the "Grapher," a computer program developed by Ohio State University.

3) C^2PC, The Calculator and Computer Precalculus Project for twelfth graders - This project uses graphing calculators and computer software to enhance the teaching and visualization of functions and limits.

4) Transitions - A mathematics course for twelfth graders who test poorly on the Early Math Placement Test and have a history of poor grades even though they have completed three years of mathematics. This course will correct deficiencies in mathematics skills and will help reduce the need for a remedial mathematics course in college.

Early Mathematics Placement Examination

During the eleventh grade, students will be given the Ohio Early College Mathematics Placement Test. This program is designed to provide students with an assessment of their present mathematics skills in arithmetic and algebra which will help them to help chart career plans as well as to determine whether they need to make course changes in the twelfth grade in order to prevent placement in a remedial mathematics course in college.

NSF Problem Solving Infusion Project

C^2ME is submitting a proposal for The Problem Solving Infusion Project to NSF in July, 1987. According to The Underachieving Curriculum: Assessing U.S. Mathematics from an International Perspective, students in the U.S. are severely deficient in mathematical problem-solving ability. The focus of C^2ME's four-year project will be to develop and implement a curriculum and professional development model which will upgrade the Cleveland Public Schools seventh- and eighth-grade mathematics curriculum to incorporate problem solving. The Problem Solving Infusion Project will: 1) establish an accurate working definition of problem solving and convey the integral relationship of problem-solving and mathematics to the Cleveland Public Schools' intermediate school teachers, 2) develop a format for the presentation of problem solving activities that will aid teachers in the development of problems and in the incorporation of problem solving into the classroom, 3) produce a set of teacher-developed problems correlated to the course objectives that will then be tested in an urban setting with a predominantly minority school population, 4) develop and implement a staff development model that will assist teachers in using new curriculum materials and in expanding their teaching techniques, 5) develop a problem-solving community computer network that will facilitate networking and aid in the formulation and dissemination of curriculum materials, and 6) establish a contest format that can be implemented in districts throughout the country. This grant will provide a unifying factor to many of the programs, such as the Oberlin Problem Solving Workshops, the Energy Problem Solving Project, and MATH REP. NSF will make its funding decisions in January, 1988.

Energy Problem Solving Project

As part of an effort to teach problem solving and to update the consumer math curriculum, C^2ME has submitted a proposal for the Energy Problem Solving Project to The East Ohio Gas Company. The project will: 1) plan and conduct a dinner symposium for math teachers that will provide a first-hand look at problem-solving applications and convey the integral relationship of energy, problem solving and mathematics; 2) develop a format for the presentation of problem solving activities that will aid teachers in the development of their own problems and in the incorporation of problem solving into the classroom; 3) develop and test energy-related problems correlated to course objectives; and 4) produce a notebook containing these problems to be used in Cleveland and in school districts throughout the country.

The Aetna Math Club Program

C^2ME will be submitting in the summer, 1987, a proposal to Aetna to help fund high school mathematics clubs. The funds will be used to grant $400 to participating schools to fund math club activities. An initial reception, early in the school year, will allow for questions of clarification, and for teachers experienced in this type of activity to share their knowledge. A main focus of club activities will be on problem solving. The main goals for this program are:

1) Support and invigorate math clubs and increase the number of clubs in the area;

2) Create and promote enthusiasm for mathematics among teachers and students;

3) Communicate to students high expectations for mathematics achievement.

4) Provide opportunities for teachers to test new instructional methods;

5) Provide multiple networking activities between teachers, between students, and among teachers and students;

6) Increase participation in mathematics contests;

7) Encourage teachers and minorities to be actively involved in the mathematics club;

8) Ultimately, foster an environment that will encourage student achievement.

SUMMARY REPORT:
DURHAM COLLABORATIVE: THE DURHAM MATHEMATICS COUNCIL

by

Urban Mathematics Collaborative Documentation Project
University of Wisconsin-Madison

PURPOSE OF THIS REPORT

This report summarizes the activities of the Durham Mathematics Council for the 1986-87 school year. The report is intended to be both factual and interpretive. The interpretations have been made in light of the long-term goal of the Ford Foundation to increase the professional status of mathematics teachers in urban school districts and the way in which the activities of the collaborative during the past year have evolved in order to reach that goal.

The information presented in this report came from the following sources: the proposal submitted by the Durham Mathematics Council to the Ford Foundation for the continued funding of the collaborative; documents provided by the project staff; monthly reports from the on-site observer; the meeting in San Francisco in October, 1986, of representatives of all of the projects; the directors meeting held in St. Louis in January, 1987; meetings held during the annual NCTM Conference in April, 1987, in Anaheim, California; survey data provided by teachers; and two site visits by the staff of the Documentation Project.

DURHAM COLLABORATIVE: THE DURHAM MATHEMATICS COUNCIL

A. Purpose

The activities of the collaborative are guided by the five interrelated themes outlined in the proposal for refunding. These themes are:

1. The empowerment of teachers to determine the mathematics curriculum. The state of mathematics is rapidly changing, with a new emphasis on such topics as finite mathematics, statistics, and microcomputer applications. As technology continues to advance, the need to update the mathematics curriculum becomes more pressing. By encouraging and supporting mathematics teachers in their development of new curricula and methodologies and providing teachers with opportunities for professional growth and leadership, the council will empower teachers to play an influential role in the process of changing curriculum. By uniting teachers in a cooperative effort, the council will help them develop a stronger voice in future curriculum matters.

2. Involvement of teachers in decision making. Too often in the past, teachers have been passive agents in curriculum reform. Rather than partners in the process of change, teachers have been the recipients of change. If teachers are to become true professionals who impact on key matters such as curriculum, they must become involved in the decision-making process. Community recognition of teachers as experts in their field is a necessary condition for such involvement.

 In light of this, the council will develop activities to aid teachers in acquiring the expertise and leadership potential necessary to foster their participation in the decision-making process. The council will concentrate on developing high visibility and support from all areas of the community.

3. Council expansion to serve teachers throughout the Research Triangle area. The Research Triangle area (Durham, Raleigh, Chapel Hill) is rich in resources and in mathematicians. Expansion of council programs to involve teachers in this area will increase council visibility and status. This growth can be expected to enhance teachers' abilities to make change happen.

4. Impacting on curriculum at the state level. An increasing number of basic curriculum matters are being decided at the state level. If the council is to empower

teachers to affect change and to set the course of mathematics education, it must expand its focus to include the state level as well. The council must assist teachers in their efforts to become involved in state decision-making processes regarding such issues as curriculum, statewide testing, and textbook selection.

5. Development of a professional mathematics community. The council's highest priority involves easing the feelings of isolation and powerlessness experienced by mathematics teachers. The council will strive to develop a truly professional mathematics community in Durham, composed of mathematicians from all sectors. The council will work to combat the negative stereotypes expressed in such phrases as "...just a teacher...", as well as to develop a base of community support in order to demonstrate the value that Durham places on mathematics and education.

The goals implicit in these themes constitute a very ambitious undertaking. The council has identified four areas in which it must succeed if the collaborative is to become institutionalized:

1. The development of a secure resource base. Over the next four years, the council must develop strategies to secure a sound, stable financial base. If long-term goals are to be set, and if teachers are to be asked to make long-range commitments, then the council must demonstrate its financial security.

2. The involvement of teachers in the decision-making process. Traditionally, teachers have not been involved in policy decisions. The council must address the existing policy framework in order to develop strategies that will involve teachers in the decision-making process.

3. The development of a broad-based network. The council must develop strategies to educate members of the mathematics community about ways they can and should work together. Traditionally, barriers have existed among people in the university, business, and public school communities. The council must find ways to transcend these barriers and to demonstrate commonality of purpose among area mathematicians.

4. The establishment of ownership of the Durham Mathematics Council. The council must strive to develop a sense of community ownership. In order to survive, the council cannot be viewed as a Ford Foundation project, nor as a program of the North Carolina School of Science and Mathematics; it must be seen as a Durham project to improve education in Durham. If the anticipated geographic expansion does occur, then the project must be viewed as a program of the Research Triangle area. The

council will need to focus on strategies to develop this sense of community ownership.

B. Context

The community of Durham--which covers the city itself and large portions of the surrounding county--has a population of approximately 160,000; 105,000 of these reside within city limits. While the city and county maintain separate governments and operate their own public services, Durham is perceived as a single community, with its advantages and problems shared by all residents.

Durham is also the county seat and has been the county's only incorporated municipality since 1869. It is located in the geographic heart of the county and is the center for all social and cultural activities. In contrast, the majority of business and industry is located outside city limits, particularly in Durham County's portion of the Research Triangle Park. County boundaries surround more than 85 percent of the Park, which employs 22,000 people at an annual payroll of $700 million.

The Durham community is served by the Durham City and Durham County school systems. The geographic districting of these two systems does not conform to city and county boundary lines. The Durham County school system, for example, operates ten schools (seven elementary schools, two junior high schools, and one high school) within the Durham city limits. Similarly, a number of county residents live within the Durham City school district and attend its schools.

The Durham city and county school systems work together in a number of areas. The local summer school program is operated by the Durham City school system, but receives funding and students from both school systems. Recently, a number of high school English teachers from the two systems joined together to work with Duke University English faculty to develop individual curriculum projects. During the 1986-87 school year, the Teacher Express Program was launched, enabling teachers from both the city and the county schools to receive discounts of 10-20 percent at many community businesses.

Both the city schools and the county schools enjoy a good reputation locally and nationally and are committed to teacher excellence. For the second year in succession, a local teacher was named the regional teacher of the year. The Durham County System has required all of its teachers to enroll in effective teacher training between September, 1986, and June, 1988. The training involves attendance at ten three-hour sessions from 3-6 p.m. or 7-10 p.m., or a one-week summer workshop. Federally supported programs in remedial reading and mathematics have been approved by the Durham City School Board.

The Durham City school system, which serves a large minority urban population, operates under the leadership of Superintendent Dr. Cleveland Hammonds. In 1987, Dr. Hammonds was selected one of the top 100 educators in North America. A new assistant superintendent in charge of curriculum was recently appointed. Prior to the beginning of the 1986-87 school year, there was also a large number of principal reassignments; six principals and five assistant principals changed positions. Durham High was without a principal from June until October, 1986.

Slightly more than half of the city system's high school students were enrolled in mathematics courses during 1986-87. Students take an average of 2.5 mathematics courses during their high school years, and under a new program are required to demonstrate computer literacy as a prerequisite for graduation. The city offers seven levels of mathematics, from remedial courses through calculus, with class size averaging twenty-one students. About 63 percent of the graduating students enter some form of post-secondary education.

Larry Coble is the superintendent of the Durham County school system. The system's student population represents a mix of urban, suburban, and rural backgrounds, reflecting the broad range of lifestyles that exist within the county.

About 80 percent of the 3,914 high school students in the county system's three high schools were enrolled in mathematics courses during 1986-87. Students taken an average of 3.47 mathematics courses during their high school years, with class size for these courses averaging 24.5 students. Fourteen general, academic, and computer-oriented courses are offered, ranging from remedial mathematics to AP Calculus and an advanced mathematics seminar. Sixty-eight percent of graduates pursue some form of post-secondary education.

The county school district will adopt a K-5, 6-8, 9-12 structure within the next three years, a change that will involve a complete reorganization of the administrative staff, as well as the construction of new schools. During 1986, county voters approved a $38.4 million bond issue, paving the way for the construction of five new schools, and other building additions. It is anticipated that the first of these new schools will be completed by fall of 1988.

The State of North Carolina controls many aspects of education in the state, including teacher salaries, state textbooks, and career ladder. In 1986, the state increased teacher supplements and added supplements for new teachers. The state is currently working toward establishing a system under which all teachers would be required to follow a standard format in classroom performance. The state and its committees are not always receptive to having district input in making decisions on education in the state. In 1986, the governor appointed a statewide textbook review committee. This committee had the authority to designate the textbooks that

could be used in the state. The committee rejected the offer from the Durham Mathematics Council to do some study of textbooks and to give the committee its opinion. The reason given was that the Durham teachers may be biased toward certain books. As a consequence, a summer workshop for Durham teachers to consider textbooks for adoption was cancelled.

The Governor has nominated Ms. Pat Neal, a member of the Durham County School Board, to the State Board, which supervises state-funded public schools. Ms. Neal's priorities include reducing dropout rates, raising teacher salaries, and improving buildings. She will provide a direct link between the Durham educational community and state policymakers.

C. Development of the Collaborative

Dr. Keith Brown, Dean of Special Programs and Research of the North Carolina School of Science and Mathematics, is project director of the Durham Mathematics Council. Dr. Jo Ann Lutz, who has a half-time appointment as collaborative director, also teaches mathematics at the North Carolina School of Science and Mathematics. Betty Peck, the on-site observer, is a mathematics teacher in the county schools.

The council found it very difficult to obtain commitments from local businesses for the matching funds required by the 1986-87 refunding proposal. Given the size of Durham, as well as the project administration's relative inexperience in fund raising, it is not surprising that the collaborative experienced problems in securing commitments. The Durham Mathematics Council has since developed a structure and a plan for fund raising and has sought assistance from persons experienced in the long-term planning necessary for securing needed funds.

An attempt is being made to link the fund raising activities of the Durham Mathematics Council to the new Durham Education Fund, which was established in 1985.

The Durham Math Council is led by a Board of Directors and a Steering Committee. The board is comprised of sixteen representatives from area businesses, higher education, and the city and county school districts, including two teachers. The board oversees the day-to-day functions of the collaborative. Five standing committees comprised entirely of board members were established in September, 1986, to aid in administering the collaborative affairs: the Executive Committee, the Nominating Committee, the Finance Committee, the Advisory Committee, and the Public Relations Committee.

The Steering Committee, which was initiated in 1985 and usually meets monthly, continues to play an important role in the collaborative. One teacher from each Durham school serves on the

committee; these teachers were self-selected in that they were the first to return questionnaires indicating their willingness to serve. The Steering Committee serves as a conduit for information between the collaborative director and area teachers. Future activities are discussed at the meeting so that the committee members can report back to teachers at their schools what will be happening. In addition, the Steering Committee has fostered a strong bond among its teacher members, who have persuaded many of their professional peers to participate in council activities.

D. Relationship with Other Local Initiatives

The Durham Mathematics Council operates out of the North Carolina School of Science and Mathematics (NCSSM), a state-funded residential high school for academically talented secondary students. It is staffed with exceptional teachers.

The NCSSM Mathematics Department has received a Carnegie Corporation grant to design a course to replace precalculus in its curriculum. The new course will address students' need for more mathematics by exposing them to new mathematics topics while retaining the essential elements of precalculus for students who wish to go on to take calculus. The activities of NCSSM's mathematics staff offer special opportunities for teachers in the Durham Mathematics Council to be exposed to new ideas and to learn more mathematics.

On January 19, 1987, the Greater Durham Chamber of Commerce's Human Relations subcommittee sponsored a forum, "Building a Better Durham Through Education." Five DMC participants attended. The forum included discussion of collaboration between schools and colleges, curriculum content, and the centrality of teaching. Dr. Ernest Boyer, President of the Carnegie Foundation for the Advancement of Teaching, was keynote speaker.

E. Project Activities

During 1986-87, the Durham Mathematics Council sponsored several types of activities, all designed to provide teachers with growth experiences. These activities originally were conceived of as a "wish list" of projects developed with teachers during the council's planning phase. Only those activities in which teachers expressed an interest were organized and offered. These activities are described in the section "Council Sponsored Activities." In addition, the council supported activities sponsored by other agencies; this support included publicizing events and providing funds to allow Durham teachers to attend. These are described in the section "Council Supported Activities."

COUNCIL-SUPPORTED ACTIVITIES

In general, out-of-school networking activities were of four types: receptions and dinner meetings, industry tours, seminars and workshops, and internships and grants. In addition, during the 1986-87 school year the council established a Teacher Resource Center and facilitated the establishment of the Triangle Math Club. The council also continued to publish its own newsletter, which serves as an important vehicle for disseminating information.

Receptions and Dinners

During the 1986-87 school year, the Durham Mathematics Council sponsored several receptions and dinner meetings. These events were designed to provide an informal setting in which teachers and mathematicians from supporting institutions could meet and socialize. They also provided a forum for disseminating information about the council.

Math Council Reception. On December 9, 1986, the Durham Mathematics Council hosted a reception for all area mathematics teachers to highlight the council's fall activities. The event, held from 4-6 p.m. at Glaxo, Inc. at the Research Triangle Park, was open to all council members, including mathematicians from industry, and colleges and universities. Dr. Miriam Leiva, chair of the Department of Education and professor of mathematics at Davidson College, spoke on, "For the Love of Mathematics." Her presentation detailed topics she uses to arouse the curiosity and spark the imagination of mathematics students. After the lecture, Glaxo sponsored a reception. Seventy teachers and several university and industry representatives attended. One teacher said, "Dr. Leiva reinforced my feeling that effective teaching is what I make it, not a checklist of procedures." Another expressed pleasure at the "opportunity to meet with people other than math teachers--let's have more events like this." Dr. Leiva noted that she was "pleased by the enthusiasm of this group," and that she would "like to see other areas with like organizations." Dr. Imogene McCanless of Glaxo, Inc., a member of the DMC Board of Directors, said, "I would have liked to have a math council when I was teaching."

Spring Dinner Meeting. The Durham Mathematics Council held a Spring Dinner Meeting on March 17, 1987, at Alexander's Restaurant in Durham. Forty-two persons, including nine members of the DMC Board of Directors, heard Steve Davis of the North Carolina School of Science and Mathematics speak on current trends in mathematics, and Kathy Lynch and Parthenia Burnette speak on their experience at the Exeter Computer Conference. One teacher noted that it was a "great opportunity to hear and be heard about what we are doing

right and what we need to change" and added "I felt like a person--not a teacher." Another noted that "we were already converted but it was good to hear an authority say that we are right." A representative from Measurement Incorporated who is also a member of the Board of Directors stated, "I do believe seeds were sown, teachers were encouraged to experiment, and all of us had our eyes opened to the needs of this country as we prepare young people to think and solve problems in the twenty-first century." A representative from North Carolina Mutual Life said, "It is good to see teachers mingling with each other and us."

Recognition Ceremony. The first annual Recognition Ceremony was held June 4, 1987, at the North Carolina School of Science and Mathematics. Twenty-seven teachers received awards for their participation in mini-grants, conferences, and workshops funded or supported by the council. The program included a welcome by Charles Eilber, Director of the North Carolina School of Science and Mathematics; a summary of Durham Mathematics Council programs by Council Director Jo Ann Lutz, and presentation of awards by Michael Bunch, Chairman of the Durham Mathematics Council Board of Directors. Fifty-one people participated, including teachers, spouses, business representatives, a principal, and both math coordinators. A reception followed the program.

A representative of Duke Power Company commented, "I didn't realize quite how busy you have been." Mike Bunch stated, "We want all of you to know that we appreciate your hard work and accomplishments." A teacher commented, "It's exciting to find out what others had done--we have really accomplished a lot."

Industry Tour and Follow-up Session

On May 26, 1987, the council sponsored a day-long tour of the Lake Norman Power Plant to highlight for teachers the work of one major area company. Seven teachers attended the tour, which was hosted by the Duke Power Company, to hear presentations on the use of mathematics by hourly employees of the power company. The teachers were enthusiastic about the trip and the information provided, but found that one day was too short a time for the amount of information given. One teacher commented, "I can now tell my students that they must know how to solve problems using mathematics." Another said, "We were treated as if we were important, which we are. Good presentations. I now believe in nuclear power!" A third said, "The math was good--the applications were good. Duke did a P.R. job to convince us that nuclear power is good. I did not buy it!"

A follow-up session for teachers who wanted to earn professional development credit for the activity was held June 8, 1987. At this session, each of the five teacher participants presented a plan for using the tour as part of a lesson. Most

indicated that they would use the material in motivational talks to students stressing the need for the topics taught in a general mathematics class.

Seminars and Workshops

During the 1986-87 school year, the council sponsored a variety of seminars and workshops. In general, workshops were designed to improve specific teaching skills and to provide teachers with activities they could take directly into their classrooms.

Algebra II/Precalculus Network. The Algebra II/Precalculus Network was established in spring, 1986. This series of seminars and workshops on teaching mathematics at the Algebra II level and above is designed to bring together teachers of Algebra II, Algebra III, Precalculus and Calculus to share ideas and to help one another with problems.

In September, 1986, a meeting was held to plan the program for the Algebra II/Precalculus Network for the 1986-87 school year. Although a representative from each school was invited, scheduling conflicts prohibited all but six teachers from attending. It was decided that the seminars would be open to all teachers, but that meeting notices would be sent only to those who had informed the council office of their interest. The Network meets at 3:45 p.m. on the third Tuesday of each month at the North Carolina School of Science and Mathematics.

Five teachers attended the school year's first Algebra II/Precalculus Network seminar on October 21. It was anticipated that the attendance would be higher, but many teachers were in meetings for a reevaluation project in which their schools were taking part. Pat Robbins demonstrated Apple software she had developed for an algebra and geometry question bank, and gave copies to all interested teachers. Other teachers at the meeting demonstrated some graphing programs for the Apple. All the teachers who participated found the activity extremely worthwhile. One teacher said, "As a first-year teacher, I learned a lot about much software I had never heard of." Another said, "Hands-on use of materials was very valuable." A third commented, "We were able to use programs others had tested and found useful." The teachers appreciated receiving copies of the programs that had been demonstrated.

The Algebra II/Precalculus Network met again November 18. Dan Teague, a teacher at the North Carolina School of Science and Mathematics, demonstrated MuMath, a computer program that does much of the math taught in the algebra curriculum. The demonstration was intended to stimulate discussion about the influence innovative software has on what (and how) content is taught in courses leading

to and including calculus. The fifteen teachers who attended felt that the seminar was very useful. One teacher commented: "[The seminar was] interesting and thought provoking. Good discussion." Another said, "I was persuaded to at least open my mind to new possibilities. I see this coming, I hope that I'm prepared. At least I won't have too many old habits that will have to die hard."

Because the January meeting of the Algebra II/Precalculus Network was cancelled due to inclement weather, its program was rescheduled for February 5th. Verdrey Madzimoyo and Pat Morris, the two Durham teachers who had attended the computer conference at Phillips Exeter Academy in June, 1986, reported on a Precalculus Seminar. Eighteen teachers attended.

The Algebra II/Precalculus Network met again March 24, 1987. Wallis Green presented the business applications of mathematics she learned in classes at Duke's Fugua business school MBA program. Seven teachers attended, which was fewer than expected. The teachers present seemed to feel that more teachers would have attended if the seminar were held at a time when "less pressure was on teachers." One teacher noted that it "gave us an opportunity to see how what we teach is applied." Another stated that it was "good to share Wally's experience." A third teacher said, "I found out linear programming is really used!"

Geometry Network. A series of seminars and workshops addressing issues and techniques related to the teaching of geometry was also scheduled for the 1986-87 school year. In actuality, however, only one meeting was held because most teachers already were involved in one of the other networks. At that meeting, on October 1, Vivian Leeper Ford and Parthenia Burnette gave a presentation on the Geometric Supposer at the North Carolina School of Science and Mathematics. The activity was intended to introduce teachers to the Geometric Supposer, to provide training in its use, and to allow teachers to experiment with it. A videotape on using the program was shown, followed by teachers' hands-on use of the Geometric Supposer.

The fifteen teachers who attended enjoyed the program, and several participants stayed past adjournment to "play" with the materials. The on-site observer reported that there was "great enthusiasm on the part of those who were there." One teacher commented, "The film was brief and to the point, informative, and a good introduction to the Geometric Supposer. We were allowed 'hands on' use of the software." Another responded, "[I] learned a lot about something new and useful." Other teachers commented, "I would like to be able to borrow the materials to experiment with some students"; "The activity was adequately explained and [it] showed the utility of the program. More examples of the different types of areas of usefulness would be helpful; more time on the demonstrations." A volunteer lay person commented, "Excellent program, interesting materials; probably a good beginning for what can be done in the future for geometry by using computers." The

county math supervisor said, "The series appears to be based on 'Discovery Teaching,' which I have always found to be very helpful in helping students to become more knowledgeable once they have mastered the techniques involved. Should be an excellent addition to any program using the areas covered by the Supposer."

On February 19 and 20, 1987, Richard Houde demonstrated the use of the Geometric Supposer in a workshop at Rogers Herr Middle School. All junior high and high school geometry teachers were invited to attend. Despite severe weather that caused schools to be closed that day, twenty-two teachers participated. One possible explanation for this higher-than-average attendance is that teachers may have been more comfortable participating in the workshop since they knew that they would not be missing their classes in doing so.

One teacher commented that it was "worth the trip through the ice to learn about techniques and software that we can use to great advantage." Another said, "the presenter was a real school teacher who recognizes our problems and our needs. The presentation was down to earth and practical." All five teachers interviewed by the on-site observer said they planned to use the material in their classes provided they could requisition the needed software.

Grades 6-9 Network. Responding to the requests of teachers of grades 6-9, an effort was made to form a Grades 6-9 Network. On March 25, five teachers and two DMC representatives met to discuss the possibility of organizing a Grade 6-9 network. Although those present believed that the effort was worthwhile, it was decided that considerable recruitment would have to be done in order to form a successful network. Verdrey Madzimoyo, Tonya Scott, and Kay Swenson, three teachers who had attended problem-solving sessions at the NCTM meeting in Charleston, S.C., shared their ideas and problem-solving hints.

Math Counts Seminar. On December 4, the council offered a seminar on the "Math Counts" program at the North Carolina School of Science and Mathematics. John Goebel, a teacher at NCSSM who has helped to develop national-level Mathcounts tests, talked about this year's special topic, which is functions, and shared his ideas about how to teach the concept of function to seventh and eighth graders.

All junior high mathematics teachers were invited, but due largely to conflicts with the reception for cooperating and student teachers at the University of North Carolina-Chapel Hill, only nine teachers attended. One teacher stated that it was an "excellent background for introducing junior high [students] to functions." Another said, "It's so nice to see energy and enthusiasm."

Workshop on Probability and Statistics. A two-day workshop at the North Carolina School of Science and Mathematics, held June 11 and 12, 1986, focused on topics to be used in the classroom or in helping students with research projects. NCSSM teachers presented morning sessions on materials for classroom use. The afternoon sessions were presented by Dr. Deborah V. Dawson, Assistaut Professor of Biometry and Medical Informatics in the Department of Community and Family Medicine at Duke University Medical Center.

Thirty-seven teachers attended the conference, and they were unanimously enthusiastic about the program. One teacher commented, "The activity was certainly worthwhile. Gave knowledge we can use in classroom." Another said, "Super handouts--great problems--great notes. Can't think of anything we've done that I enjoyed more." Dr. Dawson also felt that the activity was very successful and said she "was impressed with the caliber of participants--their questions and interest."

Math in Applications Workshop. On February 12, 1987, a "Math in Applications" workshop was held at the North Carolina School of Science and Mathematics. The workshop focused on providing meaningful courses to third-year mathematics students who are not ready for the algebra/precalculus track. All general mathematics teachers were invited; eleven attended.

The on-site observer noted that this activity was "probably our most successful attempt to 'connect' city and county teachers." One teacher commented that the strength of the session was in "the sharing of ideas among Durham City and Durham County teachers, high schools, junior highs and middle schools."

EQTEC Workshops. On March 13, a workshop on EQTEC--a program to encourage females and minorities in mathematics and computer use--was held at Neal Junior High School. Teachers Parthenia Burnette, Vivian Leeper Ford, Gloria Doyle, and Logan Wilkins shared what they had learned at the California EQTEC meeting. The sixteen junior high and middle school mathematics teachers who attended seemed surprised to discover that a mathematics background was not required for computer use. One teacher said, "We must begin to use what we learn to inspire our students, and stop using math to block access to computers." Another teacher said that the programs "opened eyes about how few women are in the field." A third said, "Very good workshop. I learned several motivating activities that I am going to use this year with my classes. I have already done one of the activities with my class."

On April 2 a follow-up to EQTEC was held at NCSSM. Seven teachers attended.

Seminar on Research Applications. On May 6, a seminar on the applications of mathematics and computers to research was held at

the Research Triangle Institute. Twenty-two teachers attended the program, which consisted of four 90-minute presentations and a lunch provided by the Durham Mathematics Collaborative. The presentations included: Mathematics in the Development of Disease Transmission Models, Applications of Mathematics and Computer Graphics, Silicon Chips and Mathematics of Image Analysis, and The Mathematics Involved in Computer-Generated Random Digit Dialing.

While all the teachers present thought the seminar was valuable, some commented that the 90-minute presentations were too long. One teacher said, "The workshop showed how math ties in with research. This will be motivational for students." Another said, "very interesting, but not directly related to my area (level)." A third welcomed the "chance to enhance professional growth by being made aware of other career efforts" and said, "I think the Math Council is a very positive influence and hope that it will continue to offer educators seminars, workshops, etc.!" Although the seminar was primarily planned for senior high teachers, a number of junior high teachers attended. One junior high teacher who reported that the presentations were "over his head," was still able to recall several details from the presentations as well as his perceptions about how some of the presenters viewed mathematics.

A follow-up session for teachers who wished to earn professional advancement credit for the activity was held June 16. Each teacher presented a lesson plan based on the information obtained in the seminar. Since the program stressed the use of statistics and computers, teachers' plans dealt with precalculus and computer programming classes. Computer graphics was widely used.

Workshop on Teacher Effectiveness. On June 15, 1987, a workshop on techniques for organizing a mathematics class and using instructional materials in a time-efficient manner was held at the North Carolina School of Science and Mathematics. Nearly seventy persons heard a presentation by David Johnson, the chairman of the Mathematics Department at Nicolet High School in Milwaukee and author of the books "Every Minute Counts," and "Making Minutes Count Even More." Mr. Johnson provided tips on the art of questioning, efficient homework correction, and a practical notebook system, as well as suggestions for daily organization techniques such as getting started, connecting the lesson objective with past experiences, guided practice, and quizzes and test correction. Lunch was provided by the Durham Mathematics Council.

The workshop was very well received. One teacher commented, "It was the best workshop I ever attended. Lots of ideas that I can and will use. 'Methods' professors could learn a lot from Mr. Johnson as could our 'effective teaching' evaluators." A second teacher said, "Super program--wish it could have been longer. He spoke to every error I ever made and told me how to avoid repeating them. I intend to use many of his ideas--can hardly wait for

August to start." A third teacher noted, "Excellent, enjoyable. I wish administrators could all have been there to see what an effective teacher really does."

Internships

In 1986, the council initiated a summer internship program to secure summer internships in area industries for teachers who possess the requisite skills or interests. Teacher participants receive financial support and an opportunity to use their mathematical skills. During summer, 1986, the council coordinated an internship at Central Carolina Bank for one month, and another at the Triangle Universities Computer Center. This latter placement turned out to be more clerical than was expected.

The internship program was not as successful as had been anticipated. While there is considerable interest among teachers in the opportunity to work at mathematics outside the school, this enthusiasm has not been matched by the corporate sector. As a result this initiative was dropped from the 1987 summer program.

Grants

Grants Program. The Grants Program supports innovative efforts to enrich and strengthen mathematics curriculum and provides seed money for instructional experimentation and equipment. The council has informed teachers that curriculum grants of up to $300 are available to develop or purchase classroom materials. Grant applications are reviewed by the Advisory Board of the Durham Mathematics Council. The council's fall 1986 newsletter described the program and included an application form. In May, the Advisory Board reviewed four mini-grant proposals, ranging from $68 to $600, and four grant proposals, ranging from $433.85 to $2,200. The mini-grant proposals suggested purchase of materials to be used in the classroom, including a Family Mathematics video tape and color monitors. Most of the mini-grant proposals were submitted by two teachers, which meant that the actual funds requested were limited to a total of $600. The grant proposals were for compensation to do curriculum material development during the summer. The Advisory Board questioned whether collaborative funds should be used to purchase capital equipment and to whom the equipment would belong. All but one of the grants were approved; the board asked for more information on one proposal before giving its final approval. In addition to the grant proposals, the board approved funding the attendance of five teachers at various activities during the summer. Three teachers requested funds to go to Phillips Exeter Academy (two attended in 1986). Two teachers requested funds to go to the precalculus workshop at NCSSM.

Ultimately, the board approved five mini-grants, including one submitted after the May meeting for purchase of video tapes on Management Science and Statistics; three for developing curriculum materials during the summer of 1987; and one for attending a graduate course at UNC-CH.

Study Grants. The council also offers grants for university study in order to provide mathematics teachers with the opportunity to pursue advanced study in mathematics. The council will provide teachers with a stipend that will pay tuition, fees, books, and/or release time from one class. As of August, 1986, four teachers had been awarded grants for university study; one more teacher was awarded such a grant for summer 1987.

Information Dissemination

The Durham Mathematics Council Newsletter, published approximately every two months by the council office and sent to the home addresses of every secondary, middle school, and junior high teacher in the city and county school systems, is a primary tool for information dissemination. The newsletter highlights upcoming activities, and offers reports from DMC members (including teachers who have attended conferences) and a report from the council's executive director.

Teacher Resource Center

In the spring of 1987, a Teacher Resource Center was established in a space provided by NCSSM. The Center, which is open between 8 a.m. and 5 p.m. weekdays, provides teachers access to computers, software, and text and supplemental materials. The Center also serves as a workplace away from school. Center use by teachers has been less than expected, but efforts are being made to make more teachers aware of the Center and the services it provides.

COUNCIL SUPPORTED ACTIVITIES

In addition to sponsoring activities, the Council helped to provide funds for teachers to engage in professional activities offered by other agencies. These activities typically involve workshops and conferences, state and national professional meetings, and grants. These activities also involve helping teachers form a Triangle Mathematics Club of Mathematics in the area. Teachers are encouraged to find ways to share their experiences and ideas through council sponsored activities.

Triangle Mathematics Club

During the 1986-87 school year, the Durham Mathematics Council helped to schedule several events to facilitate the establishment of the Triangle Mathematics Club, an organization designed to involve mathematicians from all sectors and to promote the growth of mathematics and mathematics education. The club, which is modeled after the Greater Chicago Math Club, is expected to become self-sufficient, to have its own set of elected officers, and to establish regularly scheduled meetings. On December 2, 1986, eight teachers attended a meeting to discuss the organization of the club.

Kickoff Dinner. On February 24, 1987, the Triangle Math Club held a "dutch treat" dinner as both a kickoff activity and a recruitment meeting. Dr. Robert Silber of North Carolina State University spoke on "A Miscellany of Math Magic: A number of Effects based on Math and Logic with Applications." All Durham-area residents interested in mathematics were invited; thirty-eight attended including twenty-three teachers from the city and county schools and from Chapel Hill schools. Participants discussed the purpose of the Triangle Math Club and the kinds of activities and programs that would be of interest to the group. While the facilities were less than ideal (among other problems, there was a general power failure that lasted 40 minutes), most participants seemed to enjoy the evening. One teacher commented that it was enjoyable to meet a "non-teacher with interests like ours." A purchasing agent for Union Carbide Agricultural Products Company-Research Triangle Park commented, "The club is needed to help all of us interested in mathematics exchange ideas and get to know each other better." Many said that they looked forward to the next meeting.

Planning Meeting. On April 14 a planning meeting for the Triangle Math Club covered such topics as governance and long-term planning. Results of a survey among interested parties were mailed out prior to the meeting.

Dinner Meeting. A dinner meeting of the Triangle Math Club was held May 26, 1987, at T. K. Tripps Restaurant. Dr. William Love of the University of North Carolina at Greensboro spoke on "Infinity--The Twilight Zone of Mathematics." Forty-two club members, including twenty-five teachers from the county, city and Chapel Hill schools, attended. The presentation was well received, although there were a few negative comments regarding the physical facilities. One teacher said, "I often get discouraged--evenings like this cheer me up--I can go back to class and try again." Another said, "The Triangle Math Club has long been needed. A good evening with people of like minds who enjoy and respond to a challenging presentation. Thank you DMC." A purchasing agent for

21-26, 1987, which focused on computer use in the mathematics classroom. Two of the teachers had attended in 1986. It is expected that these teachers will make presentations to Durham teachers about the ideas and activities they garnered from the workshop.

EQUALS in Computer Technology. In August, 1986, the Durham Mathematics Council awarded grants to four teachers to attend a five-day program sponsored by the University of California-Berkeley. The program, designed for teachers, counselors, and administrators serving grades K-12, focused on attracting and retaining women and minority students in computer education. The program was geared for both the beginning and the experienced computer user.

All four teachers who attended (three females and one male) felt that the activity was very worthwhile and that it had "great value for those who use and maintain computers." One teacher said, "I have had the opportunity to attend several workshops. . . . I must admit that I have never participated in one so challenging, inspiring, applicable, and interesting as the EQUALS workshop. It was well-planned and well-presented. We were presented with a model team-teaching situation and learned so much in so little time, it was remarkable!" The four teachers shared what they learned by organizing and presenting the EQTEC workshop for other Durham teachers on March 13, 1987.

Logo Workshop. The DMC sponsored one teacher's attendance at a two-day Logo Conference in Arlington, VA, on April 2-4, 1987.

Professional Meetings

NCCTM Meeting. The NCCTM meeting was held on October 17-18 in Raleigh, North Carolina. There was no need to allocate funds to teachers for this meeting because Raleigh is only 20 miles from Durham. Furthermore, the Friday of the meeting coincided with a scheduled workday of release time for teachers of both districts. At the NCCTM meeting, the three teachers who had attended the Family Math Workshop at the Lawrence Hall of Science in Berkeley, California, presented a workshop on Family Math. In addition, one Durham teacher attended a regional NCCTM meeting in Charlotte, North Carolina, on March 6, 1987 and three teachers attended a NCCTM regional conference in Greensboro, North Carolina, on March 27, 1987.

NCTM Southeastern Regional Conference. Four teachers from both city and county schools received stipends to attend the NCTM regional conference in Charleston, South Carolina on November 13-15.

NCTM Annual Meeting. In April, 1987, the Council sponsored five teachers' attendance at the annual meeting of the National Council of Teachers of Mathematics in Anaheim, California. The teachers, who would not otherwise have had the opportunity to attend the meetings, received funds for both travel and expenses. Each teacher was also granted release time by the school district as the district's contribution to the council. All five teachers were unanimous in their praise for and appreciation of the conference.

F. Observations

The Durham Mathematics Council has progressed in several areas of primary interest to the Urban Mathematics Collaborative project. These areas include: Project Management, Collaboration, Teacher Professionalism, and Mathematics Focus.

PROJECT MANAGEMENT

During the 1986-87 school year the management of the Durham Mathematics Council remained in the capable hands of Keith Brown and Jo Ann Lutz. A clear delineation of responsibilities has been drawn between the DMC's Director and Executive Director. Dr. Brown sees his primary responsibility as setting the council's general policy direction. He is responsible for writing the proposal for funding from the Ford Foundation; overseeing fund raising; interacting with the Ford Foundation, the Technical Assistance Project, and the Documentation Project; and, initially, identifying key people to serve on the Advisory Board. (The Nominating Committee of the board now handles this latter responsibility.) Dr. Lutz, as Executive Director, is primarily responsible for the day-to-day operations of the council, and for interacting with teachers and board members. Dr. Lutz is assisted by Barbara Davis, the Math Council secretary. Ms. Davis, who is very knowledgeable about council activities, is able to answer questions about the Resource Center and to attend meetings when Dr. Lutz is not available. It should be noted that the Math Council secretary's role extends beyond the organization's administrative or clerical requirements; the fact that the phone is always answered has proven to be of great importance in establishing contacts with teachers.

Management of the DMC has evolved into a smoothly operating system. The complementary styles of the director and executive director contribute to this cohesive professional environment. Dr. Brown thinks it is important to identify good people and then step back and let them do what they are good at doing. His presence is felt in the council's well-defined vision, and in its explicit definition of long-term goals. Dr. Lutz works through the Advisory Board and Steering Committee to help make things happen. Initially, she was more directive with these groups in order to

provide them with necessary input about the council's direction and goals. Now she primarily operates as a committee member and takes direction from the groups for developing activities. Drs. Brown and Lutz share a vision of teacher independence and decision-making to be accomplished over the next five years.

A second reason for the successful evolution of the collaborative involves the redefinition of the board structure. After several board members failed in 1986 to meet their commitments to seek out and develop funding resources, the membership and structure of the board was changed. Dr. Brown identified a single individual to be responsible for the council's finances, and the board was subdivided into five committees, each of which addressed a specific function. The committee structure seems to have been successful in maintaining the interest of board members and generating advice and direction for Dr. Lutz.

A third reason for the smooth operation of the collaborative is Dr. Lutz' ability to make things happen. A great deal of her time is devoted to overseeing arrangements for activities and meeting with teachers. She makes an effort to visit each of the fourteen schools to talk with mathematics teachers on a regular basis. In the fall of 1986, Dr. Lutz and her secretary visited each school to generate support and enthusiasm for the council; teachers' response was overwhelmingly positive. These personal contacts and the energy Dr. Lutz expends are viewed as important reasons for the variety of activities and the high level of teacher participation in the council.

The Steering Committee has become a primary source for activity ideas and for disseminating information to each school. This group has worked well as a conduit for communicating information to all teachers in the districts. Teachers who have served on the committee have valued the experience of influencing the council's activities and direction and of meeting regularly with their peers. The process for changing committee membership became an issue at the close of the 1986-87 school year. Although committee members agreed that as many teachers as possible should have the experience of serving on the committee, current members were very reluctant to give up their own participation. The issue of how the commitment of this group will be expanded to include other teachers remains a concern.

Development of the refunding proposal provided an opportunity for the council to propose a shift in its strategy for helping mathematics teachers. During the initial phase of the collaborative, a menu (or wish list) was prepared. When teachers expressed interest in a menu item, the council either sponsored an event or supported Durham teachers' participation in events conducted by others. This strategy proved of considerable value in counteracting teachers' sense of isolation from each other and from the issues and problems of mathematics and mathematics education. However, a shift in strategy is now being contemplated. While continuing to sponsor and support a variety of activities,

the council will now begin to focus its efforts on three fundamental issues:

1. the development of new topics for the fourth year of mathematics;

2. the integration of technology into the classroom; and

3. the application and transferability of mathematics.

Program activities that focus on these issues must receive positive response from teachers, must be flexible and innovative, and must be broad based enough to appeal to a wide range of mathematics teachers. It will be interesting to follow the development of these focused activities and their impact on mathematics teaching over the next several years.

COLLABORATION

The strength of the Durham Mathematics council stems from two sources: the support from the "high tech" industries in the area, and the mathematical and educational background of the staff of the North Carolina School for Science and Mathematics. The teachers at the school are knowledgeable and current on the issues related to school mathematics, and they are active in dealing with those issues. At the same time, they are classroom teachers who deal every day with high school students. The council will continue to build upon these strengths.

Members of the Steering Committee work well together and support one another. This committee, comprised solely of teachers, feels that it brings the teacher's viewpoints and insights to the collaborative. The council provides opportunities for teachers from both the county and city schools to interact with one another.

While representatives of all sectors participate in the council, teachers comprise the majority of its membership; those from outside are viewed more as resources. To date, the council has involved mathematicians from industry by inviting them to present or to share ideas with teachers. Although these industrial activities have been well received, there is some concern that this contact has been primarily the corporate sector lecturing to the teachers rather than an interaction between those from each sector. It appears that the two sectors (corporate and teachers) are not interacting with equal status; the corporate sector seems to be "giving" while the teachers are "receiving." One teacher from Junior High said that he "felt dumb" after listening to all the mathematics that he had heard about at the RTI seminar. Nonetheless, despite the perception that teachers have been on the receiving end of this communication, some barriers have been broken. Some of the teachers have begun to feel comfortable in contacting the speakers and asking them to address another group of

teachers or their students, or to have their students visit the industries. The council has been less successful, however, in involving university mathematicians. The establishment of the Triangle Mathematics Club could be an important step in building these collegial relationships.

The Council Board provides another opportunity for some teachers to interact on an equal basis with representatives of the business/corporate sector, university faculty, and other teachers. The meetings include a real interchange of views, opinions, and ideas. The experience of the two teachers on the Advisory Board seems to be very positive, and their opinions are valued as highly as are those of others.

Collaboration has also developed among teachers through their participation in activities and on the Steering Committee and between teachers and Dr. Lutz. In general, teachers feel very comfortable talking to Dr. Lutz and asking her for help or working with her; this interaction suggests sensitivity for the concerns of the teachers. For example, the teachers at Jordan wanted to develop an activity focused on probability and statistics. After they expressed this interest to Dr. Lutz and the Steering Committee, the DMC sponsored a workshop.

The DMC is involved increasingly in interactions with other collaboratives: teachers have attended summer sessions at Phillips Exeter with teachers from other sites; they have traveled to Berkeley's Family Math Workshop where they interacted with teachers from several California cities; the Philadelphia Mathematics in Applications Course has been discussed at a DMC activity; and teachers have attended professional meetings around the country.

Dr. Brown and others are aware of the importance of working with the state since many educational policy decisions are made at the state level. It must also be noted that there have been no problems with the administrative staffs in either school district and, in fact, the collaborative has worked with both school systems to meet some common goals. For example, the county is using a state grant to pay the salaries for teachers to attend the Woodrow Wilson seminar on probability and statistics; DMC is paying their expenses. Also, the county district is paying several teachers to work on other curricular projects during the summer of 1987, including one teacher who will do a project using a textbook by Saxon with an intermediate class.

As the focus of the council shifts to curricular changes in the next two years, it will be interesting to note the support and the impediments that may emerge. This is of particular importance in light of North Carolina's approach to effective teaching and assessment. Efforts to meet the state's demands could influence the perceived needs of teachers, and hence the character of council activities, especially as teacher input increases.

TEACHER PROFESSIONALISM

Although Durham teachers are not unionized, there is a very strong individual school building "work place" mentality among area teachers. Furthermore, due to the lack of a local professional organization, mathematics teachers have been very isolated from one another and from the issues and trends in the field. Collaborative activities have lessened this sense of professional isolation for many teachers. However, a large number of teachers in the area have yet to take part in any council activities. It should be noted that an initial differential in levels of involvement between county and city teachers is disappearing. A core group of participants, particularly those who serve on the Steering Committee, is emerging. These teachers form a solid base from which to draw other teachers into activities.

Dr. Lutz observes four changes in teacher behavior that she attributes in large part to the work of the collaborative. They are:

1. an increased awareness of the value of DMC activities;

2. a greater use of the DMC as a resource in supporting professional activities by teachers, both locally and at other locations;

3. a change in the way many teachers view themselves and their capabilities; and

4. an increased valuing and use of networking, i.e., using council members as resources.

As Dr. Driscoll of the Technical Assistance Project noted, while individually these changes may appear modest, collectively they signal a group developing its own sense of community. The next step, as Dr. Brown points out, involves teachers transforming themselves into change agents--no small feat in an environment as traditionally stable as Durham.

Teachers in Durham, and in North Carolina in general, work in an environment in which the state either maintains or is taking control of several key aspects of their professional lives: salary, state textbook lists, and, in the near future, career ladder. Overtly, it appears that teachers take this centralization for granted. They complain about low salaries (beginning at $16,000 and increasing after nineteen years to $28,000), but do not feel they can do anything to improve them. On the other hand, teachers from Durham have challenged some of the processes employed by the state, including the operation of the textbook selection committee. In addition, the state affiliate of the NEA maintains a political interest, lobbying the General Assembly in [illegible] lending endorsement to candidates for key offices.

There is more teacher freedom than would first appear to be the case. For example, the state prepares a list of textbooks from which schools make their choices. Other texts may be chosen as supplements. Teachers are granted a good deal of discretion in terms of the extent to which they use the primary and supplementary texts.

Teachers have also questioned some of the state mandates and the workability of some state requirements. The possibility exists that DMC activities will count for career ladder credit, if the program is enacted.

Another development initiated by the council in 1986-87 was the establishment of the Triangle Mathematics Club, a professional mathematics organization that would serve teachers from areas outside of Durham. Teachers have come to recognize that the absence of a local professional organization has inhibited their professional growth; the club could become an affiliate of NCTM and may involve mathematicians from all sectors. Those in attendance at the organizational meeting on December 2, 1986, at the North Carolina School of Science and Mathematics agreed that such a club was a good idea, that the council should help establish the organization, and that the club should sponsor dinner meetings with quality speakers. All high schools but one were represented.

The very existence of the DMC as an organization designed to serve and help teachers has made Durham teachers feel more professional. One teacher said, "Just think: they are trying to do something to help with my work." As plans for the club's organization developed, Dr. Lutz deliberately stepped back to allow teachers to take the lead. She sees the club as related to and partially supported by DMC, but not as a DMC activity. Betty Peck, the on-site observer, is one of the prime movers behind the effort. Some DMC money will be available if the $10 annual dues do not cover the expenses for next year, and the teachers do use council resources and the council secretary to send notices of the meetings. The club met in February, April and May. The first meeting had 45 participants.

The collaborative has developed in teachers a recognition of their collective expertise, and has provided a peer group in which teachers may consider themselves a part rather than as professionals working in isolation. The teachers seem to be supporting each other and getting ideas from the interaction. Teachers who have participated in Family Math, in EQTEC, and in Phillips Exeter programs, for example, have directed activities for their peers. Mrs. Betty Peck, the on-site observer, was invited to talk with teachers at a meeting at Hillside High School. One teacher said that she is the only one who teaches calculus at the school and appreciates the opportunity to talk to other calculus teachers at the Steering Committee meetings.

It should be noted that one impact of the DMC has been teachers' increased participation in professional conferences and

meetings. Through DMC, teachers have traveled to Exeter, Berkeley for Family Math, NCTM (D.C. and Anaheim), and attended courses at Duke and UNC.

The council's activities to date exhibit an interesting mix of paternalistic events offered by outsiders and a "choice" mechanism that allows teachers to select from a menu those activities in which they wish to participate. The expectation is that this strategy will nurture the development and maturation of a truly professional group of mathematics teachers.

Teacher participation in council activities increased in 1986-87 over the previous year. During the year, 69 percent of the county teachers participated in a council activity, compared to 56 percent in 1985-86. Seventy-four percent of city teachers participated in at least one council activity in 1986-87, as compared to 68 percent the previous year.

There is some concern, however, that participation in council activities has decreased among some teachers due to the implementation of new school programs in the 1986-87 school year. All county teachers are required to take "Effective Teacher Training" in either 1986-87 or in 1987-88; as noted earlier, this will require attendance at ten three-hour, after-school sessions. In addition, three schools will conduct self-evaluation and reevaluation studies for Southern Association. It is feared that this effort will be extraordinarily time consuming. Many Durham teachers do not want to miss classes to attend council activities during school hours; additional commitments during after-school hours may therefore impact on attendance at council activities. This possibility must be monitored carefully, as there is considerable work pressure on the teachers served by the DMC. The "effective teaching" sessions at night and the number of schools preparing for evaluation create an environment in which the collaborative must be sensitive to the concern that its activities may contribute to burnout if care is not exercised. This is a real concern, and it raises an important issue. On the one hand, its status as a collaborative requires that the council make real demands on teachers' time and intellectual capabilities. At the same time, however, it must not be so burdensome that it works against, rather than for, the participating teachers.

MATHEMATICS FOCUS

The mathematics focus of the Durham Mathematics Council seems eclectic. One strong emphasis involves existing curriculum and helping teachers to know more about instruction in those content areas. This is achieved through teachers networking with other teachers. At the same time, the collaborative makes efforts to introduce less traditional school topics such as probability, statistics, problem solving, and applications. These topics have

received attention by some teachers in the council through workshops, seminars and mini-grants.

A stratification of teachers exists according to the topics they can teach. Some teachers only feel comfortable in teaching courses through Algebra I, while others feel more comfortable teaching geometry. Dr. Lutz has encouraged teachers to attend the NCSSM precalculus summer workshop to help update their knowledge in more advanced mathematics.

The use of computers and technology in the schools depends upon the interest of individual teachers. Computers are more apparent in the county schools and appear to be used more often than they are in the city schools. Computer use has not been a topic of great interest to a large number of teachers.

The NCSSM has been very influential in keeping some teachers current on new developments in mathematics education. The school received a three-year grant to pay for teachers from around the state to teach at the school for one year. During this time new approaches were tested and new topics in mathematics were explored by the visiting teachers. In a few cases, teachers who came from other parts of the state chose and were able to acquire a job in the Durham area upon completing their year. These teachers, along with the few from Durham who were visiting NCSSM teachers, provide a cadre for building on some new ideas about mathematics teaching.

G. Next Steps

The collaborative will continue to offer teachers the opportunity to participate in industry tours, seminars, conferences, and workshops, and will ask participants to report back to their colleagues about their experiences. During summer, 1987, the collaborative will sponsor teachers to attend the NSF funded workshop on the precalculus curriculum at the North Carolina School of Science and Mathematics, a related workshop on contemporary topics in precalculus, and a Woodrow Wilson Institute on mathematical modeling.

Workshop on the Precalculus Curriculum Project at the NCSSM

The North Carolina School of Science and Mathematics has received funding from the National Science Foundation to run a 12-day mathematics workshop for selected teachers from nine of the eleven mathematics collaboratives established by the Ford Foundation. The workshop will be held July 6-July 17 at the Research Triangle Institute in Durham, and will focus on the precalculus curriculum development project underway at the North Carolina School of Science and Mathematics; more explicitly, the workshop will cover applications of elementary functions, including

elementary data analysis, modeling, algorithms, and the use of a computer in instruction. Each teacher will receive a stipend. Each team of teachers is expected to assist in reviewing materials to be used in in-services for teachers of grades 7-12. The team will conduct a one-week workshop during the summer of 1988 in their home district for teachers of grades 7-12.

The workshop has three practical goals:

1. to acquaint teachers with the goals of the syllabus under development at NCSSM and to prepare teachers to be able to use some of the units in their teaching;

2. to familiarize teachers with recommendations about the secondary mathematics curriculum, focusing on the need to introduce new topics such as finite mathematics, data analysis, algorithms, and the need to make more effective use of computing in the classroom; and

3. to prepare teachers to conduct one-week workshops that address the recommendations in their home districts during the summer of 1988. The workshops will be based on a set of materials developed at NCSSM during the 1987-88 school year.

Thus, each participating teacher will help test the newly designed programs that reflect the recommendations to improve the secondary mathematics curriculum, provide suggestions for improving the units after their use in the classroom, assist in the design of teacher training materials for acquainting teachers with recommendations for improving mathematics instruction, and help conduct a workshop for fellow teachers.

The project's primary goal is that participating teachers will experience a special professional opportunity, one which results in growth and a greater involvement in mathematics education. The Durham Mathematics Council has been asked to sponsor five teachers, one from each high school, to attend the workshop.

Contemporary Topics in Precalculus at NCSSM

During the past two years, the mathematics faculty of NCSSM has, under funding by the Carnegie Corporation of New York, developed a syllabus for fourth-year college preparatory mathematics. The new syllabus incorporates recommendations about the secondary mathematics curriculum from such organizations as NCTM, MAA and NSF, and includes such topics as data analysis, algorithms, and the need to make more effective use of computing in the classroom.

The collaborative will fund four DMC teachers to attend the workshop, which will be held July 13-24. The workshop will

acquaint teachers with the goals and topics of the syllabus under development at NCSSM, with emphasis on those topics that are generally considered new to the more traditional "precalculus" course and on the use of the computer as a tool in classroom instruction. After participating in the workshop, teachers will be prepared to use some of the new units in their own classrooms.

Mathematical Modeling Residential Institute

Two teachers, one from NCSSM and one from the county, will receive collaborative funding to attend a Woodrow Wilson Institute for teachers of secondary school mathematics at Columbus College, Columbus, Georgia, on July 25-31, 1987. The four-week residential institute will be open to high school mathematics teachers with three years of experience and continuing employment. Fifty teachers from across the country have been chosen by competition to attend. The institute will focus on mathematics modeling using discrete and other school mathematics. It is anticipated that the two collaborative teachers who attend will present a workshop for teachers from across the state in summer 1988.

Other Plans for 1987-88

During the 1987-88 school year, the council also will continue to make funds available for teachers to visit schools with model programs. As in 1986, grants will be offered to teachers for classroom improvement. The Study Grant Program, which encourages teachers to pursue university study, also will be continued.

The collaborative plans to schedule several dinner meetings during the 1987-88 year. These meetings will feature an invited speaker who will discuss relevant topics in mathematics and mathematics education, and will provide a forum for teachers to present results of their projects. The Council is also beginning to explore the use of cable television as a means of serving the entire mathematics community.

The Math Council is in the process of establishing a teacher Resource Center. The center will include a test bank organized by teachers, textbooks for review, and computers and software to test. The DMC Resource Center will be located at NCSSM, next to the Math Council Office. Teachers are being encouraged to help organize the center.

In June, 1988, the Durham Mathematics Council and the North Carolina School of Science and Mathematics will host a national mathematics conference on the theme "Teacher Professionalism: The Role of the Mathematics Teacher." Experts from across the nation will be invited to speak. Topics will include changes in

curriculum, the state of the mathematics teaching force, and trends in technology and their effects on the role of the teacher.

SUMMARY REPORT
LOS ANGELES URBAN MATHEMATICS/SCIENCE COLLABORATIVE (LAUM/SC)

by

Urban Mathematics Collaborative Documentation Project
University of Wisconsin-Madison

PURPOSE OF THIS REPORT

This report summarizes the activities of the Los Angeles Urban Mathematics/Science Collaborative during the 1986-87 school year. The report is intended to be both factual and interpretive. The interpretations have been made in light of the long-term goal of the Ford Foundation to increase the professional status of mathematics teachers in urban school districts and the way in which the activities of the collaborative during the past year have evolved in order to reach that goal.

The information presented in this report came from the following sources: the proposal submitted by the Los Angeles Mathematics/Science Collaborative to the Ford Foundation for the continued funding of the collaborative; documents provided by the project staff; monthly reports from the on-site observer; the meeting in San Francisco in October, 1986, of representatives of all of the projects; the directors' meeting held in St. Louis in January, 1987; meetings held during the annual NCTM Conference in April, 1987, in Anaheim, California; survey data provided by teachers; and five site visits by the staff of the Documentation Project.

LOS ANGELES URBAN MATHEMATICS/SCIENCE COLLABORATIVE (LAUM/SC)

A. Purpose

The Los Angeles Urban Mathematics/Science Collaborative is the official title of the thirty-five-member Advisory Committee to the Los Angeles Educational Partnership. This committee, established in 1986, was created from the consolidation of the advisory committees of the Los Angeles Urban Mathematics Collaborative and the Mathematics/Science Fellowship Advisory Board. The Advisory Committee currently provides direction to the Los Angeles Educational Partnership on the operation of four programs: +PLUS+ (Professional Links with Urban Schools), Mathematics/Science Teacher Fellowship, Science and Math Enrichment Program, and Target Science. The Advisory Committee was restructured in order to reduce duplication of committee memberships, and to bring together those concerned with mathematics and science education.

The goal of the +PLUS+ program of the Los Angeles Urban Mathematics/Science Collaborative is to use a mathematics resource network to assist teachers in relating the world of work to the mathematics curriculum. It is expected that teachers will benefit from expanded horizons and increased interaction with their colleagues. +PLUS+ activities during the 1986-87 school year included an expansion and continuation of those cited in the original funding proposal: networking and collaboration among teachers, mathematics departments, and mathematics resources were expanded from the community level to encompass state and national resources; team building and leadership skills for mathematics teachers were further developed; teachers were provided opportunities to develop, evaluate, and integrate new materials and methods into the curriculum.

It is anticipated that +PLUS+ activities will enable teachers to:

1. become a part of the mathematics resource community through interaction with mathematicians and their professional organizations;

2. perceive themselves as effective, empowered agents of the professional education community; and

3. discover new and effective ways to motivate students to study mathematics, which in turn will increase the number of students successfully completing high school mathematics programs and increase student awareness of the importance of mathematics.

B. Context

The Los Angeles Unified School District's K-12 enrollment increased by 11,000 students during the fall of 1986, to a total enrollment of 590,287. Nearly 155,000 of these students attend high schools or magnet schools. Nearly 14 percent of all California public elementary and secondary students attend Los Angeles schools, and the Los Angeles schools enroll 45 percent of all students in Los Angeles County.

The Los Angeles Unified School District employs 29,221 teachers in grades K-12 at an average annual salary of $30,337. About 79 percent of the district's $3 billion operating budget comes from state funds; 9 percent comes from local property taxes, 8 percent from federal funds, and 4 percent from other sources. The average cost of educating a Los Angeles school district pupil during 1985-86 was $3,402.09.

Enrollment for the 1987-88 school year is projected to increase by 15,000 students, the majority of whom will have limited English skills. Steady enrollment increases have pressured the superintendent and the School Board to develop a plan to address school overcrowding. In December, 1986, the School Board delayed for a year a decision to convert additional schools to year-round programs. Instead, the Board approved the addition of 265 portable classrooms, and transferred 9,000 students from overcrowded schools to schools with available space, changing the integration ratio from 60:40 to 70:30. The delay in converting to a year-round school program allowed more time for planning.

The district is also struggling to address a dearth of qualified teachers, especially in inner-city schools; teacher walkouts; and the potential disruption of new district leadership. Los Angeles lost many mathematics and science teachers when the courts ordered that faculty desegregation precede student desegregation; many teachers chose to leave the system rather than to relocate to inner-city schools. This has greatly reduced the number of experienced and qualified teachers, especially in fifty-five inner-city schools. As a result, these schools have been granted priority in hiring new staff. In addition, the district's requirement that mentor teachers be willing to change schools to help inexperienced teachers has caused many mentor positions to remain unfilled. The district has only four mentor teachers of mathematics in all of its junior and senior high schools, in spite of the fact that the state contributes an additional $4,000 to the salaries of mentor teachers.

The teachers' union in Los Angeles (an affiliate of NEA) is not very strong. Teachers' salaries range from $20,000 to $38,000, a pay schedule many teachers view as inadequate. To illustrate, teachers were discouraged to learn that the workers who change the combinations on school lockers receive a starting salary of $31,000 after only six weeks of training.

Finally, Superintendent of Schools Harry Handler resigned at the end of the 1986-87 school year, although he has agreed to serve as a consultant for one year to assist Superintendent Leonard M. Britton, who was appointed after a nationwide search.

C. Development of the Collaborative

The thirty-five-member Advisory Committee to the Los Angeles Educational Partnership, which constitutes the LAUM/SC, has been chaired since March, 1986, by Erwin Tomash, chairman of Dataproducts Corporation. The Advisory Committee is responsible for developing policy for the four mathematics and science programs administered by the LAEP. The Collaborative Advisory Committee is comprised of the lead teacher from each +PLUS+ school; Board of Education members; administrators and instructional specialists from the Los Angeles, Pasadena and Inglewood unified school districts, the El Monte Union High School District, and the Los Angeles County Office of Education; and representatives from foundations, museums, corporations, professional organizations, and postsecondary institutions. Selected members of the Board of Directors of the Los Angeles Educational Partnership also are invited to serve as ex-officio members of the committee. The Collaborative Advisory Committee meets as a whole two or three times each year. Peggy Funkhouser, Executive Director of the Los Angeles Educational Partnership, is director of the collaborative. The coordinator of the +PLUS+ program is Toby Bornstein. The on-site observer is Richard Curci, a high school mathematics teacher and a mentor teacher.

The Ford Foundation's Urban Mathematics Collaborative project funds the +PLUS+ (Professional Links with Urban Schools) program. Steering committees are designated as needed to plan and organize +PLUS+ activities. Teachers, business associates, and college associates who participate in +PLUS+ activities are considered program members. In April, 1985, the mathematics departments at three high schools were selected from a targeted group of forty-seven mathematics departments to form teams with representatives of business and higher education in order to strengthen mathematics instruction and build links to the world of work. A +PLUS+ team, including the participating teachers, two business associates, one university associate, and a facilitator, was formed in each of three schools: Manual Arts and Wilson High Schools in the Los Angeles Unified School District and Mountain View High School in the El Monte Union High School District.

Teachers' Council

During the 1985-86 school year, the Teachers' Council, a group comprised of teachers from the three +PLUS+ teams, was established

departments to the +PLUS+ program and to disseminate application materials. Twenty-nine persons attended in addition to those presenting the program. Members of the original three +PLUS+ departments spoke on the opportunities available through +PLUS+, and how these opportunities had resulted in personal and professional growth, and offered an overview of the requirements and commitments expected of +PLUS+ departments. The +PLUS+ teachers from the original cohort schools did most of the talking, with Project Coordinator Toby Bornstein speaking briefly at the start and close of the meeting.

Participants at the orientation meeting seemed excited about the prospect of applying and particularly enjoyed the presentations by the original +PLUS+ teachers. One teacher commented, "+PLUS+ sounds interesting. It helps teachers directly. I enjoyed hearing teachers' comments." A principal said, "This is a program my school could benefit from and we will be applying. I'm glad I came."

The program planned to add five new departments, two from LAUSD and three from outside of the district, for a total of four LAUSD schools and four county schools. All interested departments, including those that had participated as +PLUS+ departments during the 1985-86 school year, were required to apply. Finally, eight schools, including two of the original +PLUS+ departments, participated in the process. The teachers and administrators from the schools were interviewed in March, 1987, by a committee consisting of the project coordinator, one teacher from a current +PLUS+ department, and one school administrator. One school withdrew its application during the interview process, after realizing it lacked the commitment critical to success. The remaining seven departments were selected for the training part of the program to develop a department proposal. Included in the seven departments were two of the three original +PLUS+ departments, Mountain View and Wilson School, and five new departments: Franklin, Jordan, Morningside and Venice High Schools, and Washington Preparatory High School. One of the original three +PLUS+ schools, Manual Arts, decided not to reapply for funding although it is giving consideration to participating in the spring 1988 workshops.

Leadership Meetings. On March 16, 1987, a Leadership Meeting was held at the LAEP office for department chairpersons and team leaders from the seven participating departments. The meeting was designed to help the department prepare for the proposal planning meetings scheduled in April and May. Fourteen persons attended, including two representatives from LAEP and two consultants hired by +PLUS+ to facilitate the successful assimilation of the new departments into the +PLUS+ program. At this meeting, participants reviewed the problems and accomplishments of +PLUS+ during its first year, discussed the role of a leader in +PLUS+, attempted to identify strengths, weaknesses, potential problems and solutions unique to their departments, and discussed the importance of

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achieving broad participation during the planning phase. Participants felt the meeting was very helpful. One person commented, "I enjoyed being here. We all seem to have the same kinds of political problems at our schools." Another appreciated the opportunity to meet together: "Sometimes we don't know who we are working with until we sit down and talk." One of the consultants noted, "Everything went as planned and I think it was successful. The leaders have a better understanding about the process. I was pleased at how well it went. We have a good group of leaders."

To assist the smooth introduction of the five new +PLUS+ departments, teachers involved in +PLUS+ during its pilot year were asked to serve as facilitators and discussion leaders at the April and May proposal planning meetings. Fourteen pilot teachers met with consultants on March 23, 1987 at the LAEP office to prepare for this role. Participants learned that the basic responsibility of a facilitator involved assisting group members to use their meeting time effectively and efficiently. Specifically, the pilot teachers were directed to encourage each person in the group to participate, to discourage individual domination of the group, to clarify the tasks at hand, and to keep the group on task and on time.

One teacher commented, "Knowing what the end results should look like helps. Using us [as facilitators] is an excellent idea. Glad to know we could help." Another said, "Too bad we didn't have this kind of help the first time around." One of the consultants added, "I'm pleased to see how helpful these teachers are and how open they are."

Proposal Planning Meetings

April Meeting. On April 4, 1987, the first of two +PLUS+ proposal planning meetings was held at the ARCO Towers in downtown Los Angeles. The meetings were designed to help both the new and the continuing +PLUS+ departments begin to develop their department plan, which would lead to the production and submission of their $2,500 grant proposals. Of the eighty +PLUS+ teachers invited, sixty-three attended. The program included instruction on identifying the mathematics education problems the +PLUS+ department would address, using problem-solving strategies to resolve these problems, setting priorities, and developing a proposal. Lunch was provided, and each teacher received a $50 stipend. Teachers active in +PLUS+ during its pilot year served as facilitators and group-discussion leaders.

Teachers in attendance were pleased with the workshop. One commented, "I'm glad I came. Bringing us together was a great idea. We share the same needs. We need to speak to the district as a group and let them know what we want. We certainly have the power right in this room." Another said, "Bringing teachers of the

same subject together to talk was a great idea. My department and I learned some things about ourselves we didn't know. Now that's worth our time."

The consultants also were pleased with the results of the workshop: "I feel this was very successful and these teachers worked hard. I'm very happy with the way it went," one reported. A teacher who was active during the pilot year noted that "it was much better than Phase I. We have learned a great deal and it paid off."

Following the April meeting, Toby Bornstein visited each of the seven schools to ensure that the proposals would be finished for the May meeting.

May Meeting. The second meeting to help the departments refine their proposals was held May 2, 1987, at the Hughes Corporate Headquarters. Fifty-three teachers and seven Hughes or TRW representatives attended. Each department presented a first draft of its proposal, and the documents were reviewed and critiqued in small groups. Meeting leaders presented a role-playing demonstration that highlighted potential communication problems and poor problem-solving techniques in the context of a departmental meeting. Departments then met to rework their proposals and to discuss problem areas. Lunch was provided and teachers received a $50 stipend.

Teachers seemed to feel that the workshop was worthwhile. One teacher commented, "Today was a learning experience with teachers helping teachers. It was well organized. I learned from reviewing other schools' proposals about my department's proposal. The comments were extremely helpful." Another said, "Even though it's Saturday morning, I'm glad we came. This was so helpful and this facility is beautiful. We needed other input and the other schools gave it. We need more meetings like this. We are a new +PLUS+ school and so far it's been very supportive." A Hughes retiree commented, ". . .it's good to see teachers working together. This is a good process. Seems the proposals need more time to be thought out. I used to write proposals for Hughes, it meant my job. You can call me for help anytime." The on-site observer noted that the departments had progressed far beyond their counterparts of a year ago.

As a further aid to +PLUS+ departments, Judy Johnson and Dick Cone, the consultants hired by +PLUS+ to help departments with their proposals, visited each school during the proposal writing phase. Each site visit focused on the department's objectives and the generation of multiple strategies to achieve those objectives. This type of consultation will not be continued in future +PLUS+ program expansions, as teachers in general did not find it to be effective, and in fact, perceived the consultants as taskmasters.

June Meeting. Teachers from the seven +PLUS+ departments met at Morningside High School on June 1, 1987, to present their completed proposals and to hear the other teams' proposals. Twenty-two members of the +PLUS+ math departments attended. One teacher commented, "Even though we come from different areas, there are many similarities in our situations. Some schools sound like ours. Others are somewhat different. It was interesting to see the direction we each took for our p' 's." Another said, "I enjoyed hearing what the other schoo are doing. I got some good ideas. We hope ours will be accepte. I think it is important we listen to each other." A third stated, "Listening to the way seven different schools run a math department was a lesson in itself. Everyone went away one step closer to their plan and each school had more respect for the others." LAUM/SC Coordinator Toby Bornstein reiterated the on-site observer's comment that the departments were "far ahead" of corresponding departments from the pilot year. She gave much of the credit to Dick Cone and Judy Johnson for helping focus the teachers' efforts.

Grant Review

A grant review panel met June 25, 1987, to make recommendations for proposal improvements and to suggest specific implementation strategies to the grantees. Grants will be awarded formally in the fall; recipients will then participate in an implementation retreat.

It should be noted that the new mathematics departments that were added to the +PLUS+ program are eligible to receive only one planning grant. This restriction was established to ensure that departments will not become overly dependent on outside funding and will more readily incorporate +PLUS+ activities into their regular procedures. (The three original +PLUS+ departments were exempted from this restriction during 1986-87).

The goals expressed in the departmental Action Plans varied for each team. A brief description of some components of the Action Plans is presented below.

DEPARTMENT ACTION PLANS

Because individual department Action Plans reflected the problems identified by teachers in each of the seven participating departments, they varied in focus and content. Mountain View High School, for example, addressed perceived problems of teachers' lack of knowledge about computers, students' lack of awareness of the relevance of mathematics in the world of work, and an unacceptably high failure rate by planning to provide release and in-service time for teachers to review computer software, developing a tutorial program for students, and inviting guest speakers from

business and industry. Woodrow Wilson's Action Plan focused on enhancing computer use in the classroom, while Franklin High School, with a 42 percent dropout rate, has chosen to devote its resources to improving students' study skills and academic performance, both in mathematics and across the curriculum.

Other innovative strategies developed in the plans include Jordan High School's program to improve student attendance and increase student motivation by providing $1 reward coupons twice monthly to students who exhibit perfect attendance and improved achievement; Morningside's emphasis on acquiring such curriculum support materials as overhead projectors and manipulatives, and its planned development of a team-teaching approach; Venice High School's plan to establish a mathematics department office as a means of fostering department cohesion and cooperation; and Washington Preparatory High School's decision to introduce innovative teaching methods, hands-on laboratory experiences and guest speakers to stimulate students' interest in mathematics.

D. Relationships with Other Local Initiatives

A variety of institutions and organizations in the Los Angeles area serve as resources and offer professional opportunities for mathematics teachers. Both the Los Angeles Council of Teachers of Mathematics, of which the president-elect is a +PLUS+ teacher, and the California Mathematics Council hold annual meetings for mathematics teachers. +PLUS+ teachers not only attend these meetings, but are active participants who give presentations and provide leadership.

Institutions of higher learning also offer courses, institutes, and special programs in which +PLUS+ teachers can participate. In the summer of 1986, a +PLUS+ teacher attended a UCLA conference on the influences of testing on the mathematics curriculum, and four +PLUS+ teachers participated in UCLA's High School Mathematics Project.

The high degree of participation in activities sponsored by other organizations has increased the visibility of the +PLUS+ program in the mathematical community of the Los Angeles area. In the words of the on-site observer, "I'm beginning to see many of the same faces at a variety of math-related conferences, workshops, meetings and planning sessions. Members of the math community are getting to know one another and +PLUS+ teachers are represented everywhere." Many teachers have also noticed "familiar faces" at mathematics conferences.

E. Project Activities

The Los Angeles Urban Mathematics/Science Collaborative's +PLUS+ project sponsors three distinct kinds of activities: events for teachers from the forty-seven targeted schools in the eleven school districts (General Activities); activities for the three +PLUS+ teams (Activities for +PLUS+ Departments); and activities designed by each team as part of its Action Plan (Team Activities). These are described in Subsections of the Section "Collaborative Sponsored Activities."

During the 1986-87 school year, the collaborative supported the attendance of +PLUS+ teachers at several conferences, both within California and out-of-state. These are described in the section "Collaborative Supported Activities."

COLLABORATIVE SPONSORED ACTIVITIES

General Activities

+PLUS+ Workshop Series

A major effort of +PLUS+ Phase II during the 1986-87 school year involved a four-part series of Saturday morning content workshops at Wilson High School. Teachers from forty-seven high schools in eleven school districts were invited to attend the workshops, scheduled November 8, December 13, January 10, and February 21. The workshops were planned by a task force comprised of +PLUS+ teachers and associates from higher education and industry, as well as other members of the Los Angeles Urban Mathematics/Science Collaborative. The workshops, which focused on topics identified by the Workshop Steering Committee of the LAUM/SC, were titled: FUNdamentally Math, New Directions in Mathematics, Effective Software for the Math Classroom, and Scientific Uses of Mathematics Modeling/Advanced Math. A session on each of the four topics was offered on each of four Saturdays.

The thirty-three workshop instructors represented a variety of groups: six instructors represented corporations, six represented universities and colleges, five represented the county or district administration, and sixteen were teachers from ten schools. All the workshops were highly interactive and applied a hands-on approach, incorporating manipulatives, models, and simulations. Similarly, all four workshops stressed problem solving, estimation, and mental arithmetic, and the use of calculators in exploring real-life applications of mathematics.

Each workshop topic was addressed in four half-day sessions, for a total of sixteen hours over a four-month period. Teachers

earned one salary-point credit from the Los Angeles Unified School District or professional expert pay of $150, one half paid by the LAUM/SC and one half contributed by their school district.

During the weeks between workshops, participants practiced and applied the new ideas and methods in their own classrooms and reported their results at the following sessions. This strategy provided the opportunity to field-test new ideas in a variety of settings, receive suggestions from colleagues, request new information and feedback from experts, and feel a sense of ownership in the process. This strategy also recognizes the developmental nature of learning, sets in motion the integration of new information into the mathematics program, and most importantly, recognizes the central role of the classroom teacher as the agent for change.

The end product of the workshop series was the Teacher Resource Book, developed by participants at each workshop for their own use and for possible dissemination to all participants. These books contain ideas, field-tested lessons, worksheets, lists of material resources, bibliographies, and lists of guest speakers. Rather than disseminating all the Teacher Resource Books, a decision was made to take one "best idea" from each Resource Book and assemble them in a single book which will be distributed during the 1987-88 school year.

Planning Meetings. The workshop's Steering Committee felt very good about the planning meetings and the overall value of the workshop series. After the committee's first meeting, an industry associate said, "This is an exciting project and it is interesting to see how schools operate differently from Hughes. I'm glad I could participate." After a later meeting, one teacher said, "I'm glad I'm a part of it. This is going to be a great series of workshops." An industry associate commented, "This is opening up positive dialogue between classroom teachers and administrators. It's transferring what teachers need to the power structure of teaching."

In late August, 1986, the workshop Steering Committee met to help two of the subcommittees finalize their fall workshops. After this meeting, one teacher commented, "We are almost finished, and it is worth every minute." Others said: "Glad to see some industry people working with us. They have good advice"; "The team work is good to be a part of. The strength is in working together."

On September 5, 1986, a luncheon meeting was held to coordinate the fall workshops, to report on progress, and to plan for the presenter's orientation scheduled October 2. After the meeting, one teacher commented, "Every time I come to one of these I feel energized. There is a group of outstanding people assembled." The on-site observer said, "Everyone was excited to be involved, and there was mutual respect by all who attended."

To encourage attendance at future workshops, collaborative coordinator Toby Bornstein announced that any teacher who brought a colleague to the December 13 session would receive $40 to purchase extra materials for his or her school, and the new teacher would receive a pro-rated stipend of $110 for attending the three remaining sessions.

December 13 Workshop. The December 13 workshop offered sessions on problem solving, experiments and game theory in the theory of fair division, the Geometric Supposer, and statistics. Fifty-five teachers attended, including fifteen who had not attended the first workshop. Overall, teachers rated the workshop 4.5 on the 5-point scale, and their comments were very positive: "These are the best workshops"; "The Geometric Supposer is fantastic. Can't wait to use it"; "This is exciting. We are learning about statistics"; and "These are by far the best (workshops). Great atmosphere and everyone is friendly. Small size gives all a chance to participate." The on-site observer added that the quality of the speakers and the size of the groups contributed to the event's success. Alan Amundsen, one of the speakers, was very encouraged by the number of participants who had preregistered for the software workshop and suggested that the proximity of a holiday may have been responsible for the relatively low turnout in November. Amundsen also suggested that workshop participants may have spread the word about the events' value, prompting additional teachers to attend. Participants' evaluation forms indicated that many would use workshop ideas in their classrooms.

January 10 Workshop. The January 10 workshop offered sessions on the use of the abacus and calculator, game theory, software used in teaching statistics and functions, and the use of vectors in the design of trusses and bridges. As with the previous workshops, the sessions focused on using mathematics effectively in the classroom and making it exciting, meaningful, and useful for students. Forty-seven teachers, all of whom had attended at least one of the two previous workshops, were present. Overall, teachers gave the workshop session a rating of 4.4 on a 5-point scale. One teacher expressed a hope that +PLUS+ would "offer these workshops again." Another said that it was "fun to 'stretch' in math again. . .it's been awhile." A third teacher appreciated the "collegiality of my individual group and [the] challenge of the problems." Presenter Barbara Wills of Huntington Park High School, LAUSD, said, "The teachers were great: motivated and open to new ideas. It was a pleasure being here."

February 21 Workshop. The February 21 workshop offered sessions on the use of computer data bases and graphics software, applications of logarithmic and exponential functions to real-world problems, and Euler's classical formula relating the faces, edges, and vertices of polyhedra. The forty teachers who attended gave

the workshop an overall rating of 4.5 on a 5-point scale. One teacher called the workshop "exciting, enlightening, interesting." Another said that "[the workshop] provided several types of applications that are based on exponential theory, yet are very relevant to high school students." Another liked "the discussion during the last part of the session as to what's happening in math today and what shall/should we do tomorrow. [It was] better than all the other sessions."

A few of the presenters, primarily those from the Los Angeles Teacher Education and Computer Center (TECC), expressed the view that +PLUS+ should not duplicate the efforts of other organizations already sponsoring workshops for teachers. By the time the +PLUS+ series ended, however, these presenters seemed ready to acknowledge its value. Workshop participants also found the sessions very helpful. According to the on-site observer, one of the workshop's most positive contributions to teachers' professional well being was its role in bringing together representatives of a wide variety of sectors, including the city and county school district administrations, city and county schools, TECC, industry, and higher education, to accomplish a task. The process has fostered meaningful communication and increased interaction and listening among participants.

In responding to a questionnaire asking for an overall evaluation of the workshop series, teachers made several positive comments regarding the value of participation. One teacher said, "I learned that there are a lot of people in industry and higher education who are as concerned about the quality of secondary education as are the secondary teachers." Another said, "Interaction with other teachers, and in particular industry representatives, has given me a different perspective in my individual teaching situation." A third stated, "I've learned about some trends in applications and theory that could affect the future content of math curriculum in secondary schools." Nearly all teachers indicated interest in continued communication with other participants and presenters.

Workshop Assessment Meeting. On April 29, 1987, twelve teacher coordinators, presenters, district personnel, and math teachers met to assess the completed workshop series and to discuss changes to be made when planning future workshops. Among other recommendations, it was suggested that sixteen hours of EQUALS workshops be offered as part of the next workshops series, as well as sessions on probability and statistics, the Geometric Supposer, and the use of calculators and problem solving across subject areas for basic math students. Several suggestions addressed administrative concerns in an effort to streamline the workshops, to provide more flexibility, and to ensure their continued success. A LAUSD math resour - person, for example, commented, "We are using too many people to coordinate these workshops. Next time let's not use 40 people to plan a workshop for 45." A teacher said, "I like what was said about bringing in industry. They certainly have

helped us in the past. We need their continued support." A representative from the Los Angeles Council of Teachers of Mathematics noted, "These workshops are good and you should do them again. You've been able to accomplish what LAUSD can't and that's getting teachers out on a Saturday morning."

Activities for +PLUS+ Departments

Phase I End-of-Year Dinner and Resource Exchange

On June 3, 1986, +PLUS+ participants met for dinner at the South Pasadena School District Office Building to share what each of the three +PLUS+ schools had learned and accomplished during the 1985-86 school year as a result of their collaborative involvement. Nine teachers from Mountain View, five teachers from Wilson, Janet Freeman from Hughes, two UCLA associates, Dr. Newman, and the director and coordinator of the collaborative project attended. Ms. Bornstein had asked the teachers to submit "one great lesson" they had developed; each teacher received copies of all the lessons that had been submitted.

Before dinner, a representative from each team discussed its progress during the year. A discussion of professionalism and a brief update of plans for Phase II of the collaborative followed the dinner.

Participants noted that the facilitator's role had evolved into that of a director who assumed responsibility for team activities. This had occurred after it was determined that teams had not taken the initiative to plan their dinner meetings, and facilitators were asked to become more involved in organizing and coordinating these events. At Manual Arts, where the facilitator had resigned, Toby Bornstein had assumed these responsibilities.

The teachers appeared to be very positive about their teams' progress during the year; that sense of accomplishment had increased tremendously by June. One teacher said, "It is hard to believe how much we have accomplished. It was good to reflect and see what we have accomplished. We needed to do this so we could move on." The on-site observer commented: "This was a necessary meeting for all members of +PLUS+. It was rewarding to see them discuss what +PLUS+ has done for them. The sharing that took place and the new networks that they have set up made this year much better for them. Perhaps, most importantly, they felt more professional and good about themselves and their fellow +PLUS+ teachers."

Hughes Aircraft Brainstorming Session

On December 15, 1986, two or three teachers from each of the three +PLUS+ schools were invited to attend a brainstorming session to identify ways in which industry could interact meaningfully with teachers. The meeting was held at Hughes from 4 to 6 p.m. and included a buffet dinner. Fourteen people attended, including three teachers from Mountain View, three Hughes employees, five Hughes retirees, Peggy Funkhauser, Toby Bornstein, and Richard Curci. Participants found the meeting was worthwhile, and the representatives from Hughes appeared to be very interested in education and in helping teachers and students. One Hughes representative said, "I'd like to impress upon girls that math is an option. I'd like to try to have an effect on somebody." The on-site observer noted that the meeting was stimulating and productive, and that the groundwork was established to encourage teachers and industry people to work together in the classroom. "Everybody in the room felt that something special was happening."

Session on Promoting Effective Interaction

On January 15, 1987, members of the Los Angeles Urban Mathematics/Science Collaborative met at the Northrop Corporate offices to discuss ways to promote effective interaction between teachers and industry associates. Five teachers, thirteen industry associates, and ten representatives from LAEP, LAUSD, and the higher education community attended. An overview of the four Los Angeles Educational Partnership programs was presented. Janet Freeman, +PLUS+ associate from Hughes Aircraft, then presented the results of her efforts to create links between +PLUS+ teachers and Hughes retirees. Finally, Kaye Storm, IISME Program Director from San Francisco, presented the IISME model of industry internships which has been adopted by LAUM/SC. Questionnaires were distributed to industry associates to determine their interest in LAEP programs. Those present generally agreed that IISME offered great opportunities for teachers. The teachers who attended were enthusiastic about the program.

Breakfast Meeting

In conjunction with Barbara Nelson's visit to the Los Angeles Urban Mathematics/Science Collaborative, the project sponsored a breakfast meeting on February 12, 1987, at the Los Angeles Chamber of Commerce. Fifteen industry and university representatives, district employees, and high school teachers were present to hear Ms. Nelson speak on the Ford Foundation's Urban Mathematics Collaboratives program and the activities of the collaboratives nationwide. Those in attendance found the presentation and discussion very stimulating. One teacher commented, "I found what

Barbara had to say very informative. I'm glad I was invited." Another stated, "To hear what's going on nationally is a help. You know you are not alone. I had a pleasant time." A third said, "Gave us enough empowerment so we can push the right buttons to make things happen." A Community Service representative from General Telephone said, "I found what Barbara had to say interesting. It made me glad that I could be involved with +PLUS+ and hopefully be of some help."

Geometric Supposer Demonstration

On April 8, 1987, Richard Houde of Weston High School, Weston, Massachusetts presented a demonstration of the Geometric Supposer. Sixteen teachers attended the demonstration, which was held at Wilson High School. In the first part of the program, Mr. Houde taught a lesson using the Geometric Supposer to a group of students while the teachers observed. During the second hour, Mr. Houde directed the teachers in activities using the Geometric Supposer. The Los Angeles Unified School District provided substitutes for teachers who wished to attend. The teachers were impressed, both with Richard Houde and with the software program. One teacher commented, "Mr. Houde's skill with the software was matched by his ability to quickly assess where the students were. Observers were amazed at how many topics he was able to cover in a short period of time." Another teacher noted that using the Geometric Supposer did not mean less work for the teacher, but required a different kind of relationship between the teacher and students.

Teacher Associate Pairs Program

The Teacher Associate Pairs (TAP) program, or "telephone buddy" database, was established to facilitate meaningful interaction between high school mathematics teachers and mathematics professionals in the world of work. Teachers participating in the program were matched with outside resources in three major areas: mathematics, application areas, and form of interaction. Associates were first interviewed and then matched with teachers in the database.

The first TAP activity, scheduled in June, 1987, featured four Hughes associates who presented topics from Geometry, Algebra II, Consumer Math, and Computer Programming to Mountain View High School students and teachers. The presentations focused on calculating escape and orbital velocities for spacecraft, fuel costs for spacecraft payloads, the costs of making a surfboard, and careers and training in computer programming.

revision involved acquiring materials and software to enrich the mathematics lab.

Manual Arts

Activities at Manual Arts have been directed toward providing for the basic needs of the mathematics teachers. By the end of the first funding period, the department had decided not to apply for continuing funds in 1987-88. It is possible, however, that the department will apply for funds for the 1988-89 school year.

COLLABORATIVE SUPPORTED ACTIVITIES

Professional Conferences and Association Meetings

Conference on Computers in Secondary School Mathematics at Phillips Exeter Academy. In June, 1986, one teacher from each +PLUS+ team and the project coordinator of the +PLUS+ program attended a conference on computers in secondary school mathematics in Exeter, New Hampshire. The Technical Assistance Project sponsored two of the teachers, and LAUM/SC sponsored the third teacher and the coordinator. The conference focused on the impact and application of the computer in the curriculum. Other topics included discrete mathematics, new developments in mathematics, and issues in mathematics education. The conference allowed teachers hands-on experience with computer software.

During the conference, the teachers attended two evening sessions on the Geometric Supposer presented by Richard Houde. Teachers from collaborative projects around the country participated in the workshop, which was organized by EDC. In addition, EDC sponsored a social gathering to provide an opportunity for teachers from all of the collaborative sites to become acquainted.

All three teachers and the +PLUS+ coordinator found the conference to be extremely beneficial. One teacher said, "The best conference I ever attended. I had a chance to work with many different softwares." Another said, "This was a well-organized conference with many things to learn and do. I enjoyed every minute, especially meeting other teachers." The teachers presented what they learned at the California Mathematics Council-Southern Section on November 21, 1986.

In summer, 1987, the LAUM/SC provided financial support for seven +PLUS+ teachers, one from each +PLUS+ department, to attend the Exeter Computer Conference. The costs of transportation, room and board were provided by the collaborative, in conjunction with the UMC Technical Assistance Project.

High School Math Project. During the summer of 1986, the collaborative funded four teachers from Manual Arts High School to attend the High School Math Project at UCLA and California State University-Los Angeles. The conference, which ran from June 30-August 1, provided high school mathematics teachers the opportunity to interact with their peers, to learn new approaches to teaching mathematics, and to prepare a mathematics workshop. The conference appeared to be an excellent growth experience for all four teachers. One teacher said, "I enjoyed learning some new things. Having to present a workshop was most beneficial. All teachers should experience this." Another said, "I feel this was outstanding. It was highly organized. The math portion and mentor teachers were good."

National Conference on The Influences of Testing On Mathematics Education. On June 27 and 28, 1986, the collaborative sponsored a teacher from Manual Arts High School and the on-site observer to participate in a two-day conference on testing in mathematics education at UCLA. The conference was sponsored jointly by the Mathematical Sciences Education Board of the National Research Council and The Center for Academic Interinstitutional Programs of UCLA. The event's primary purpose was to gather input from experts regarding the design of a major national study of the impact of testing in mathematics education. While the teacher who attended reported the discussion to be "a bit over my head," he did find it interesting.

California Mathematics Council, Southern Section Conference. On November 21 and 22, the California Mathematics Council held its annual conference for southern California in Long Beach. Four +PLUS+ representatives participated in a session about the collaborative. Toby Bornstein, the collaborative coordinator, presented an overview of the +PLUS+ program, including a review of which school districts were eligible to join. Jim Wigton, of Mountain View, described the program in greater depth and discussed its benefits. Evelyn Torres-Rangel, of Wilson, discuss: the Exeter conference, the Geometric Supposer, and the ways she used the software in her classroom. Pam Grey, of Manual Arts, added details to the discussion of the Exeter conference and offered information about some of the other conference sessions. About fifty people attended at least part of the session, including Dr. Norman Webb from the UMC Documentation Project. The three teacher participants felt good about their presentations; it was the first time any of the three had presented to a large group. Several other +PLUS+ teachers also made presentations. Lorrie Freeman of Manual Arts talked about bilingual education, and Tom Walters of Wilson talked about a trigonometry identity useful in solving cubic equations.

LACTMA Conference. The 10th Annual Los Angeles City Teachers Mathematics Association Conference was held February 27-28, 1987,

at Loyola Marymount College. Approximately 260 California teachers attended, with more than twenty +PLUS+ teachers or associates playing active roles as presenters, presiders, or officers. The conference was well received by the +PLUS+ teachers who attended. One teacher commented, "I learned something about probability I could use in my class." Another said, "I picked up some good tips for my classes." The collaborative encouraged participation, although it did not offer financial support. Teachers from Mountain View, who had never attended LACTMA, were invited this year because of their involvement in +PLUS+.

NCTM Annual Convention. The Los Angeles Mathematics/Science Collaborative funded twelve teachers to attend the annual meeting of the National Council of Teachers of Mathematics in Anaheim, California, on April 8-11, 1987. Five teachers were selected by lottery from those attending the 1986-87 Workshop Series, and one teacher was selected from each of the 1987-88 +PLUS+ mathematics departments. The Los Angeles Unified School District provided substitutes for six additional teachers who wished to attend the convention. Participating teachers were enthusiastic about the convention and enjoyed both the workshops and the opportunity to socialize with their colleagues. One commented, "I can use what I've been seeing in my class, and eating with other teachers has provided some great conversation. Last night we were talking about schools of the future." Another said, "I'm glad I won the chance to come down because I am excited about what I've seen. The session I attended on computer software was helpful and interesting." The on-site observer noted that one teacher who attended "has had a positive change in attitude toward teaching. He is trying new things for the first time in a long time."

Secondary Mathematics and Science Technology Institute (MSTI). Forty Los Angeles County math and science teachers attended a four-week residential program July 6-31, 1987, at the Lawrence Hall of Science. Several +PLUS+ schools submitted applications and three (Mountain View, Venice, and Huntington Park) were selected. Richard Curci, project documentor, was an instructor at the institute. Enthusiasm generated by the residential program is expected to produce a +PLUS+ workshop under the direction of Janet Miller, Huntington Park High School.

Summer Internships

A summer internship program was piloted during the summer of 1986. Originally, the collaborative arranged for industries to make seven positions in local industries available to teacher interns for a six- to eight-week period. Each teacher was to receive a weekly salary of $400 to $600. The program was designed to pair each teacher with an industry associate, who would serve as a resource person in regard to both corporate work and classroom

application. As part of the program, the Teacher Interns would be required to develop a unit project or a set of supplementary materials to augment the existing curriculum. Furthermore, the interns were to participate in regularly scheduled weekly meetings with the industry associate to discuss applications of the summer work experience to classroom teaching. Participating teachers also were to attend weekly half-day field seminars with other +PLUS+ teachers.

In reality, only one of the seven internship positions was filled, as most teachers had already made summer commitments by the time the program was announced. Also, the application form included a survey of computer experience that many teachers found intimidating. Some teachers believed the program would not actually materialize; others did not believe they had anything to offer industry. The coordinator felt there was too little time to develop the program, given the multitude of other accomplishments during the project's first year.

In conjunction with other Urban Mathematics/Science Collaborative programs, six teachers were identified to work in industry during the summer of 1987. Four of the six teachers who would be participating are from +PLUS+ schools. It is interesting to note that teacher applications increased ten-fold over the previous summer, while the number of positions offered by industry remained constant.

F. Observations

The Los Angeles Urban Mathematics/Science Collaborative made considerable progress during the 1986-87 school year. Discussion of the collaborative's growth during the year is organized into four sections: Project Management, Collaboration, Professionalism, and Mathematics Focus.

PROJECT MANAGEMENT

The establishment and development of the Los Angeles Urban Mathematics/Science Collaborative has been based on two fundamental strategies. The first involves focusing initial efforts on the mathematics departments of three target schools, and increasing the number of target schools each year. This approach has been necessary because of the sheer size of the area being served by the collaborative in terms of distance, number of districts, number of teachers, and number of students. The collaborative's second strategy involves encouraging collaboration by forming teams comprised of teachers, university associates, and industry associates. The teams serve as a central force in fostering greater leadership among teachers, in increasing effectiveness, in

developing networks among the various groups, and in improving the mathematics curriculum.

The collaborative is managed to a great degree by coordinator Toby Bornstein, with advice from the Advisory Committee, and with the help of activity-specific steering committees. The steering committees, such as those used to plan the +PLUS+ Workshop Series, have proven very useful in dividing responsibilities among a number of people, including teachers, and university and industry associates, thereby decentralizing leadership.

As a result of this structure, some teachers are beginning to take more initiative, as demonstrated in the planning of the Geometric Supposer presentation on April 8. That Ms. Bornstein felt her attendance at the session was unnecessary supports the observation that teacher autonomy is increasing.

As the project continues to move from its initial developmental phase, the organizational structure must adjust as necessary. Greater complexity and numbers will demand a wider distribution of responsibilities. The growth of a cadre of teachers experienced in the +PLUS+ project and the development of the Teachers' Advisory Council will facilitate some redistribution of work and foster greater teacher ownership in the overall program. The need will persist, however, for coordination and administrative support. It will be of interest beyond the particularities of the Los Angeles collaborative to document how these developmental issues will be addressed over the next several years. Not only will the projected development of +PLUS+ involve an increasing number of schools, but the total will increase by greater increments each year. There were three schools involved in the pilot period of 1986-87; the number increased to seven in 1987-88, and will expand to fifteen in 1988-89. The number of participating districts will remain constant.

Ms. Bornstein has assumed responsibility for communication within the collaborative. In addition to updating the advisory committees on collaborative activities and preparing activity reports, she visits the three target schools to talk with teachers during their breaks and lunch times in order to maintain personal contact with them and to keep them informed. The manner in which communication links are established and maintained as the number of participating schools increases will provide one indication of the viability of collaborative growth. It appears that expansion will demand increased delegation of responsibility to the teachers. This does, in fact, seem to be occurring. In planning the +PLUS+ workshops, teachers assumed responsibility for communicating with one another. Electronic mail also will be used to maintain communication among the various +PLUS+ sites.

Spreading the word about the collaborative to the larger community, comprised of the forty-seven schools, has presented a more difficult problem; such simple but essential processes as ensuring that collaborative information is directed to the correct

person in each district has been a challenge. During the first year of the project, the coordinator depended on the mathematics supervisor in each district to identify those who should receive collaborative information, but this was not very productive and resulted in low attendance at collaborative events open to all districts. During 1986-87, the collaborative coordinator identified the key person to receive information in each district, and the number of districts represented at general events increased. Teachers at the various schools learned about the workshops through their department heads and through fliers sent by the collaborative. Workshop attendance also increased as teachers spread the word about the quality of the sessions. Increased interest in the collaborative suggests that information is being disseminated and the change in collaborative procedures indicates that lessons are being learned.

The collaborative has made inroads into the districts. Mr. Les Winters, the mathematics supervisor of LAUSD, has attended several activities. Local school districts also have agreed to pay half of the honoraria for teachers who attended the +PLUS+ workshops. Barbara Nelson of the Ford Foundation met with LAUSD'S superintendent as a result of the efforts of Peggy Funkhouser, the Executive Director of the collaborative.

School involvement extends beyond the induction and funding year. All +PLUS+ schools retain representation on the Teacher Council indefinitely. As the project expands, a more complex structure will be needed. Already Erwin Tomash, co-chair with Hal Slavkin of UMSC, is considering this problem from a corporate manager's point of view.

COLLABORATION

One collaborative objective is to promote a feeling of camaraderie among the mathematics teachers within each +PLUS+ school. The three target schools varied greatly in terms of how the teachers had related to one another prior to joining the +PLUS+ project. Manual Arts mathematics teachers were isolated in separate buildings and interacted only rarely. Wilson mathematics teachers met as a department occasionally and would see one another throughout the school day. Mountain View mathematics teachers met regularly at school and socially at a dinner gathering once each month. After a year of collaborative participation, each school has experienced some changes that appear to have resulted from collaborative activities. At Manual Arts, an empty room has been converted to an office for mathematics teachers. This space enables mathematics teachers to congregate over lunch or while preparing materials, and it appears that the teachers have initiated some level of group communication. While some teachers have assumed individual or small-group projects, such as establishing a tutoring program involving college students and painting an office for mathematics teachers, there remains a sense

that group communication could be improved. At Manual Arts guest speakers have been invited to the school and steps were taken to make contacts with an industry logistics expert.

At Wilson and Mountain View, mathematics teachers communicate on a regular basis. At Wilson, the six +PLUS+ teachers frequently eat lunch together, and have socialized outside of school by participating in a collaborative-initiated camping trip; this relationship is a direct result of their association with the collaborative. At Mountain View, the high level of interaction among the mathematics teachers has continued throughout their collaborative involvement. While the collaborative has facilitated communication within all three schools, the degree of team building varies by school. The evolution of communication among teachers at Manual Arts will be a true indication of the impact of the team approach.

Planning meetings for the +PLUS+ workshops and dinners have encouraged interaction among teachers from different schools. The effectiveness of these activities is evidenced by the participation of teachers from different schools in cooperative activities, such as joint presentations. In one instance, a teacher at Mountain View taught classes for a teacher at Wilson.

Within each site, team management and the collaborative direction have depended to some degree on the group's cohesiveness prior to collaborative involvement. The resolution of organizational issues appears to be as important as the consideration of instructional issues. Thus, dual focuses have emerged in the +PLUS+ program: the first is a concern for leadership development, and the second is an increased emphasis on the mathematical and pedagogical content of activities. Schools progress on these individual issues at independent rates. Organizational and pedagogical issues will continue to exist concurrently, and, in fact, may become more complex as schools join the collaborative and an increasing disparity emerges among schools in terms of their experience with the program.

The +PLUS+ Workshop Series provided an environment that fostered collaboration. Teachers, industry representatives, and college professors worked together to develop and to present the workshops. The Workshop Steering Committee and the groups planning each of the four workshops met several times. Teachers provided significant input to the speakers (other teachers, and representatives from industry and colleges) as to the approaches that would be most appropriate with teachers, the content that would be of interest, and how that content should be presented. These groups reviewed the presentations before they were given and offered suggestions. Workshop instructors from industry and colleges were encouraged to limit workshop content and to use language that would be meaningful to teachers. Teachers from Wilson assumed a great deal of the responsibility for workshop preparation, such as ensuring that presenters had access to the

appropriate equipment, including overhead projectors, TV monitors and VCRs.

The workshops also were presented in a spirit of collaboration. A teacher generally introduced the speaker, reviewed the schedule for the day, and reminded other teachers that at some point in the day they were to write activities for the Teacher Resource Guide. Speakers were teachers, university professors, or representatives of industry, and several workshops included members of all three sectors, which offered participants an opportunity to alter their perspectives on the topic under discussion and to come to understand that they all had much in common. In some workshops, interaction among teachers, professors, and industrialists was encouraged further through small-group discussion. For example, all the participants had been confronted at some point with students or employees who would derive solutions to problems that failed to match the physical conditions or that were very unreasonable in other ways. These workshops fostered a high degree of collaboration in which one participant was not lecturing to another, but all were interacting at the same level and all--teachers, professors, and industrialists--were benefiting.

Another important form of collaboration has involved interaction among teachers, both in the context of +PLUS+ activities, and within +PLUS+ schools themselves. Prior to the existence of the collaborative, teachers had limited opportunities to interact. Many schools have not routinely held mathematics department meetings. Because of their association with the collaborative, Wilson teachers during 1986-87 met during a lunch period once each week. While the teachers at Mountain View met regularly prior to their involvement in +PLUS+, this is not a typical situation in all schools.

In addition, the +PLUS+ program has provided a strategy for institutionalizing networks among teachers, and between teachers and others. The participating departments are contributing significantly to a sense of community beyond their individual buildings and districts, forming the basis of a long term diffusion process, which has as its endpoint general institutionalization of the social relationships and professional linkages established.

The collaborative also has provided teachers with more direct access to school district administrators. Many teachers had never talked with Les Winters (LAUSD mathematics supervisor) until he attended several workshops. In addition, Peggy Funkhouser reported that, as a result of his meeting with Barbara Nelson of the Ford Foundation, Mr. Winters is considering using the collaborative as the structure through which to implement the state mathematics framework in the Los Angeles Unified School District.

TEACHER PROFESSIONALISM

The planning process for the +PLUS+ workshops offered an impetus for the development of teacher leadership. The workshops were prompted by the pilot teachers' need to develop classroom applications for ideas they received through contact with other practicing mathematicians. Teachers helped set guidelines, select topics, and develop the model and evaluation instrument for the workshops. They helped identify presenters and served on the individual planning teams for each workshop. Many acted as teacher coordinators, ensuring that the workshop guidelines were followed. In addition, they oversaw the sharing of field-tested ideas by workshop participants for inclusion in each Teacher Resource Book.

Teacher initiative and leadership at each of the schools also are emerging, with a particular focus on mathematics and teaching. As the original three +PLUS+ departments come to grips with their own leadership problems, the lessons they have learned are being applied in subsequent leadership workshops for the Phase II schools. Experience, for example, has emphasized the necessity of departmental cohesion, resulting in a revised approach to the development of collaborative techniques and team building based on that cohesion.

At Manual Arts, teachers organized some activities and created their own office space. While these successes were accomplished by two individuals, their efforts were directed at improving the work situation of all of the teachers. In addition to establishing their own office space, two teachers at Manual Arts have expressed interest in the position of department head, resulting in the need for an election.

At Wilson, six of twelve mathematics teachers are +PLUS+ members. Initial reports from Wilson indicated that, while the teachers were meeting, no one had assumed leadership. As the school year progressed, and with the beginning of the 1986-87 school year, however, individual teachers began to take the initiative. The group went on a camping trip. A teacher visited Boston to learn to use the Geometric Supposer and then presented a workshop; this teacher also convinced the school to use the software in four of eight geometry classes, which required solving scheduling problems and garnering support from the principal. Another teacher was instrumental in establishing a computer room. All of these activities point to emerging leadership.

At Mountain View, the sense of department cohesion was strong even before its collaborative involvement. Program participation has fostered the association of Mountain View teachers with teachers in other schools. Also, the team has sponsored several activities and, as at Wilson, more individuals have assumed such responsibilities as making presentations at conferences, and planning and conducting workshops.

This development is taking place in an environment in which teachers often feel that they are not treated as professionals. They have no opportunity to attend professional meetings; a teacher who wants to attend a meeting must arrange with other teachers to cover his/her classes. Some teachers thought they would be unable to attend the NCTM meeting in Anaheim because of the difficulty in gaining release time. Teachers share a perception that innovative work is unrecognized and unrewarded. Mathematics teachers are not provided office space; the rooms in some schools designated as mathematics department offices were built as small storage areas. This limiting environment is amplified by the presence of those teachers who are ambivalent about activities that may foster professional growth. Some teachers view their work hours as 8 a.m. to 3 p.m., Monday through Friday. In the target schools, many teachers who hold these views have chosen not to participate in the +PLUS+ program.

The three pilot sites have provided an interesting contrast and a good test for the collaborative. While progress is evident at all sites, the degree of each department's involvement varied substantially. Two schools will continue their involvement in 1987-88, and the third may reapply to participate in 1988-89. The level of a department's participation in the +PLUS+ program was influenced somewhat by the level of teacher involvement and the working relationships among staff prior to +PLUS+. The issue now is whether--and how well--the lessons learned at the three schools are being applied to the other five sites as the collaborative expands.

One factor that has emerged as essential to significant participation by an active group of teachers is the involvement of the department head. In the pilot sites, this involvement varied greatly. At Mountain View, the department head has been very active in the +PLUS+ program and has attended activities with other department teachers. At Wilson, the department head has not been integrally involved in the collaborative, but has been supportive of the activities the project has initiated. On the other hand, a leadership problem appears to exist at Manual Arts. Two teachers at the school have been active in the collaborative, but their participation has not been accompanied by a concerted departmental commitment. The department has not followed through as a group on its proposed activity; it appears that one reason contributing to this lack of enthusiasm is the decreased level of involvement or interest the department head has exhibited.

Mathematics department heads have the power to influence change. They are elected by the teachers, they are assigned a free period each day for departmental business, they receive an additional $500 per semester, they assign teachers to classes with the approval of the principal, and they designate the amount of curricular material classes are to cover by the end of the semester.

MATHEMATICS FOCUS

The collaborative's mathematics focus has emerged from the +PLUS+ Workshop Series and from individual teachers' interests. Unlike many collaboratives, the LAUM/SC is not centered on a general theme, such as an emphasis on problem solving. Instead, teachers from the target schools have identified areas of interest or need, suggested resources to help address the topics, or used team grant money to purchase needed materials such as calculators. Among the topics addressed at the Workshop Series were applications of mathematics in science and business; discrete mathematics, including operations research, fair division, game theory, and geometry; software for teaching mathematics; and computer applications.

A short session presented prior to the last of the four +PLUS+ workshops concentrated on computers in the classroom. The workshop's presenter suggested that computers can be used in three ways: (1) as an object of study (language skills, hardware, programming); (2) as a tool (word processing, data sheets, spread sheets, and applications software); and (3) as an aid for instruction. She explained how different levels of thinking are used with each tool and how these levels relate to problem solving.

The workshops in general exposed teachers to some contemporary mathematics, although the degree of their exposure varied among individual teachers. The workshops apparently have impacted on classroom teaching. In an early workshop, for example, Janet Freeman of Hughes talked about trusses; a teacher in attendance went back to her class to teach a session on trusses in which weights were extended from a thread until it broke. Then a truss was built with the same size thread. The students found that the truss would hold more weight. After the teacher explained this, Ms. Freeman noted that the equation did not support this finding, that is, if the same thread was used, the truss should in fact support less weight. This anecdote suggests that some teachers may not fully understand all of the principles underlying the lessons they are presenting to their students. Nonetheless, teachers are experiencing and thinking about ways that mathematics is used and ways that it is changing.

G. Next Steps

The Los Angeles Urban Mathematics/Science Collaborative will continue to foster teacher leadership and guidance and to concentrate on team building. The collaborative is to become a forum for addressing and meeting the needs of mathematics educators in Los Angeles County by bringing together organizations and institutions to promote the learning of mathematics and the pursuit of mathematics-related careers.

The number of departments in the +PLUS+ program increased from three to seven during the 1986-87 school year, and will increase to fifteen during 1987-88. Manual Arts High School has chosen not to apply for renewal of its grant as a participating +PLUS+ department. It may, however, exercise its option to reapply for a grant in 1988. The mathematics department is still maintaining some level of involvement in that it will continue to have a representative on the +PLUS+ Council.

Some collaborative programs, such as the workshops, will be offered to teachers in all forty-seven targeted schools. Efforts will be directed towards making teachers aware of collaborative-sponsored activities and increasing the number of teachers who participate in them.

As planned, the annual cycle of events will involve fall workshops for all teachers; applications by and selection of mathematics departments to become new +PLUS+ teams; submission of Action Plans by +PLUS+ teams; and realization of the activities outlined in the Action Plans, including spring collaborative workshops and summer internships. The fall 1987 workshops will be planned at a meeting in July; coordinators and presenters will then work independently over the summer to refine their workshop plans. Presenters and teacher coordinators will meet in October.

Collaborative efforts to provide modems and telephone lines to access the Teacher Education and Computer Center (TECC), Mathematics/Science, and the Space Program bulletin boards have been impeded by a withdrawal of state funds for equipment and services and the suspension of state funding for TECC and its electronic bulletin board. A small Common Ground network will be established in its place, and plans to collaborate with the California Museum of Science and Industry are being pursued. It is hoped that a communication link can be established that will encourage and facilitate networking among +PLUS+ teachers, and among these teachers and other mathematics resources in southern California.

Efforts will be made to encourage more +PLUS+ departments to join the TAP, (Teacher-Associate Pairs) program. A meeting will be scheduled at which representatives of each +PLUS+ department will learn more about TAP and will have an opportunity to volunteer to serve on a teacher committee charged with refining the model. TAP developments will be integrated into the planning of departments' use of external resources--a collaboration retreat in early 1988 and the 1988 Workshop Series.

The collaborative will continue to provide opportunities for +PLUS+ department teachers to attend local, state, and national seminars and mathematics conferences. During summer 1987, the LAUM/SC will also send four teachers to the North Carolina School of Science and Mathematics for the NSF-funded seminars on the fourth-year college preparatory curriculum. These teachers will

conduct a workshop during the summer of 1988 for twenty local teachers.

MEMPHIS URBAN MATHEMATICS COLLABORATIVE

A. Purpose

As stated in the funding proposal submitted to the Ford Foundation, the primary goal of the Memphis Urban Mathematics Collaborative is to promote an environment of professionalism for mathematics teachers and to assist them in broadening their horizons; to establish creative working relationships between mathematics teachers and other professionals in colleges and universities, and in business and industry; and to develop creative projects that will result in teachers' improved abilities to relate mathematical concepts to students in a practical way.

B. Context

Memphis has a population of 646,356, with a racial mix that is 47 percent black and 53 percent white. School system enrollment totals 105,000, of which 72.3 percent of the students are black, and 27.7 percent are white. More than half (53.9 percent) of the families in the school district are classified as low income. Many of the students in the district live without one or both parents and work as much as 30 to 40 hours per week in addition to attending school. Many join the military on leaving school, a number continue to post-secondary education, and others find work in the area.

The Memphis school district was recently rated among the most segregated school systems in the South by a University of Chicago study. The average black student in the Memphis city schools attends a school in which only 18.4 percent of students are white. Many white families have left the inner city and moved into the county school district. In addition, many private school systems have emerged within the city. Desegregation of Memphis public schools was ordered by the courts in 1972.

The Memphis School System ranks twelfth in the nation in terms of size, and forty-eighth in the nation in terms of per-pupil expenditure. The district is comprised of twenty-seven high schools, twenty-six junior high schools and an "optional school" program (a magnet school within a school in twenty-two schools, eleven of which are high schools). One of the schools in the collaborative, White Station Junior High, has been named as one of the "Ten Great Schools" of Tennessee for 1987; the award carries a $10,000 grant.

Students must pass a proficiency test in order to earn a diploma; the test standard is at about the eighth grade level. Students are allowed to retake the test four times, and those who

do not take the test or fail to pass it receive a certificate rather than a diploma. The school district is experiencing some public pressure about student performance on state tests. On both the Basic Skills Test (grades 3, 6 and 8) and the Stanford Achievement Test, district students scored below the state average.

The Inner City School Improvement Program (ICSIP) is housed in the new Martin Luther King Educational and Cultural Center, which was dedicated March 13. The program offers after-school tutoring, an after-school homework center, peer programs for drug abuse and teenage pregnancy, adult vocational courses and computer education. About 370 students enrolled this year in summer school, peer counseling, or neighborhood clean-up clubs. It is anticipated that adults will use the center to prepare for the GED, to take vocational courses and to discuss parenting skills.

The school system employs 345 mathematics teachers; 50 percent are black, and 50 percent are white. Of the 345 mathematics teachers, 321 are certified to teach mathematics; not all of the certified teachers are currently teaching mathematics. Consequently, it can be surmised that at least twenty-four of those teaching mathematics are not certified to do so. Seven of the certified teachers hold doctorate degrees, 59 have course credit beyond a master's degree, 107 hold master's degrees, and 148 hold bachelor's degrees. Marietta Harris is the K-12 Mathematics Consultant for the district. She and three mathematics supervisors are responsible for evaluating district mathematics teachers.

The district textbook committee is comprised of teachers appointed by the mathematics consultants and supervisor, usually on the recommendation of principals. As an incentive for participation, teachers are granted one unit of credit toward recertification for every sixteen hours of committee work. The Southern Association requires teachers to earn six units every five years to retain their certification.

The superintendent of the Memphis City Schools, W. W. Herenton, is nationally respected. Executive Educator magazine named Herenton as one of 100 outstanding school managers in 1980, 1984, and again this year. Under Herenton's direction, the district has established ten new goals for the 1987-88 school year, including "to strengthen collaborative relationships with colleges, universities and the private sector."

Political discussion continues about the possible consolidation of the city and county school districts. Several sensitive issues are involved. In the city schools, 77.5 percent of students are black, compared with 14.5 percent in the county schools. Furthermore, it is estimated that $109 million is needed to rectify the building problems of the two districts: county schools are severely overcrowded while the city schools are in great need of maintenance.

State legislative action continues to impact directly on the Memphis schools. The county property tax rate was not raised, although a four-cent tax was shifted from one line of the budget to fund school improvements, contributing about $1.75 million to the city and county schools this year. Curricular changes stemming from the Comprehensive Education Reform Act of 1984 include revised college admission standards that require algebra I and II and geometry, prerequisites for mathematics courses for degree program credit, and college remediation programs. These changes will affect both the content of high school courses and the district's retention rates. The selection of new texts, in effect until 1993, was influenced by both the Act and the recommendations of the College Board.

The Governor of Tennessee has established a career ladder for teachers consisting of three steps. Teachers can progress by taking tests and submitting to an evaluation of their classroom teaching. At the first level, teachers are required to have four years classroom experience and a passing score on the National Teachers Test. Level 1 teachers receive an extra $1,000 for a ten-month contract. Level 1 teachers with nine years of teaching experience can reach Level 2 by receiving acceptable evaluations from two state-designated evaluators, the principal, a district mathematics supervisor, and one class of students selected by the teacher. Level 2 teachers receive an extra $2,000 for the ten-month contract and are eligible to work an eleventh month to receive an additional $2,000. Level 2 teachers with thirteen years of teaching experience can reach Level 3 by successfully meeting additional evaluation requirements. Level 3 teachers are entitled to an extra $3,000 for ten months and can receive another $2,000 for an eleventh month (an additional 70 professional hours) or another $4,000 for twelve months work (140 additional professional hours).

During 1986-87, teachers at career ladder levels 2 and 3 were allowed some flexibility in accruing the extra hours required for the eleventh- or twelfth-month salary increment. Teachers could tutor students after school or on weekends during the regular school year, serve on the collaborative's advisory board, or develop and present a workshop to other teachers. However, time spent on self-improvement or professional growth activities, such as workshop attendance, could not be applied toward the required hours. Some teachers worked the extra 140 hours within the ten months of the school year, were paid for twelve months and still had two summer months free. Other teachers taught summer school to complete the 140 hours. The state contributes the needed funds to pay Level 2 and 3 teachers for extra months work. To retain their career ladder status, teachers at Levels 2 or 3 who do not hold a master's degree must take three hours of coursework every five years in an appropriate area other than education. At Level 3, credit hours toward an extended contract can be earned for out-of-school activities related to teaching and for conducting teacher-improvement activities.

Memphis is one of the fastest growing cities in the nation. It is, however, heavily dependent on the transportation and distribution industries. One of the major employers in this sector, Sears, announced that it is closing its Memphis distribution center in 1988, which will result in the loss of 1,100 local jobs. Four new business developments, however, promise more job openings in the Memphis area. A new Marriott hotel will hire 300 employees. Payless Cashways, a building materials business with 187 stores nationwide, plans to open three stores in Memphis. The first should be in operation in about one year, with the other two opening within two years. Great Western Financial Corporation's relocation of part of its operation from Miami to Memphis could result in 350 new jobs in the Memphis area. Since Memphis became a hub for Northwest Airlines, the traffic at the Memphis International Airport has increased tremendously, and Northwest has announced it soon will add 130 workers to its current Memphis payroll of 2,500. Most of these will be formerly laid-off Northwest workers or workers transferring to Memphis from other cities.

Memphis' recent selection as the site of a $56 million Navy testing center will have a major impact on area industry. Construction will begin in October, 1987, and the center should open in 1990. The center will test large-scale ship and submarine models. The testing center, which is expected to provide hundreds of new jobs, will also create job opportunities in local service businesses.

C. Establishment of the Collaborative

The Memphis Urban League is the funding agent for the Memphis Urban Mathematics Collaborative. In May, 1986, a planning grant of $2,500 was awarded to the Memphis Urban League to convene the four-month process of designing a collaborative and preparing a proposal. The planning group consisted of representatives of the Memphis Public Schools and of the Memphis Urban League, professors and administrators from local universities, and leaders from the business community. Teachers played a major role by offering ideas and suggestions for collaborative activities. The proposal was submitted September 4, 1986, and the grant was awarded October 9, 1986, making Memphis the eleventh and final site to be funded as part of the Ford Urban Mathematics Collaborative project.

The Memphis Urban Mathematics Collaborative is comprised of and receives support from the Memphis City Schools; five universities and community colleges; and, currently, sixteen corporations, businesses, and public agencies. The Memphis Urban League and the school system enjoy an unusually close relationship. The superintendent of the Memphis City Schools is a former member of the Memphis Urban League Board who currently serves as a member of the Board's Committee of Advisors. Nineteen of the thirty-eight members of the Board are designated representatives of Memphis

refunding to be submitted to the Ford Foundation. The addition of an "outreach consultant" position to the governing structure of the collaborative was discussed; the consultant would work with the project director and answer to the Advisory Committee. Several key issues in mathematics education also were discussed, including the role of calculus in the high school curriculum, alternatives to calculus, minimum requirements for mathematics in the Memphis City Schools, and possible changes in current curriculum.

Twenty of the fifty-three high schools and junior highs in the district were designated as target schools during the collaborative's first year of operation. Those involved in initiating the collaborative identified the target schools so that there would be an equal number from each of the four areas of the district and a racial mix. In addition, a prerequisite for involvement was that the principal of a target school had to express willingness to cooperate with the collaborative project. Mathematics teachers from the twenty target schools, who have been given first priority in terms of participation in collaborative activities, were asked to propose ideas for collaborative events. These teachers, for example, were offered the opportunity to register for summer workshops before registration was opened to teachers from other schools in the district.

Teacher information-and-input meetings were held throughout December, 1986, at various Memphis City Schools. Sixty-nine teachers attended these meetings, at which collaborative representatives discussed the project's goals and prospects and solicited information from participants regarding their ideas about summer courses, and about the Resource Associate program. Teachers also were asked to provide the names of any leads or contacts in the business community they may have had that could help the collaborative. One teacher said, "A majority of teachers at my school are willing to participate in this collaborative." Another said, "I believe in incorporating the businesses into the school scene. I think there is a lot of merit and opportunities with the program. There is a need for this." A third said, "The ability to experience mathematics in the workplace is a plus, as well as the time allowed to work with industry."

As a result of the planning meetings, four subcommittees of the Advisory Committee were formed: the Speakers Bureau Subcommittee, the Resource Associate Subcommittee, the Summer Workshops Subcommittee, and the Internship Subcommittee. These four subcommittees have been instrumental in the planning and implementation of the major activities of the Memphis Urban Mathematics Collaborative.

In June, 1987, Barbara Nelson of the Ford Foundation met with representatives of the school district administration, the collaborative, and the Memphis Urban League to discuss the progress of the collaborative over the year and the proposal for refunding. Some differences in the understanding of the purposes for the collaborative were discussed. School district support for the

Memphis City Schools are participating in a variety of new programs, including the Memphis Compact, a scholarship program funded by Chief Auto Parts, and a pilot program to test recommendations made by the country's governors. Memphis is one of seven cities to be funded by the National Alliance of Business for establishment of the Memphis Compact, a program aimed at providing a job or a college placement for every needy student who graduates from a public high school. The program also will address key issues concerning career incentives, parental control of school choice, and the school success of poor students. The Chief Auto Parts Scholarship program provides a total of $18,000 to be used to encourage disadvantaged students to remain in school. Each of eleven ninth-grade students will receive a trust fund payment of $550 annually, and an additional $1,650 upon graduation. Each student will be paired with a corporate mentor. While these activities are outside the collaborative's organization, it seems inevitable that they will affect many of the same populations of teachers and schools.

In January, 1987, the Memphis Public Education Fund was formally established. In its first initiative, the Fund solicited applications for Teachers' Initiative Grants, which could total up to $200 each and could be applied toward college tuition for mathematics courses as well as for reative or innovative instructional projects, projects using nontraditional techniques or community resources, and supplies and equipment for use in such projects. Six members of the MUMC Advisory Committee serve on the grant selection committee, ensuring a close bond between this new project and the collaborative. Of the 230 applications processed, 149 grants totaling $26,700 were awarded. Sixty schools, including several of the collaborative's targeted schools, were represented.

Middle College High School, located at Shelby State Community College, will open in fall, 1987, with a class of 100 students, of which 77 percent are black. The school will add 100 students each year for a total enrollment of 300 by 1989. The program is designed to retain students who typically would drop out before graduation. Small classes, an interdisciplinary curriculum, and an explicit, signed commitment from students to attend, to be on time, and to work at their studies are all elements of the program, which is based on the MCHS at LaGuardia Community College in New York. First Tennessee Bank donated $50,000 in seed money to the program.

E. Project Activities

A majority of the activities offered to mathematics teachers by the Memphis Urban Mathematics Collaborative were initiated as a direct result of planning meetings held with teachers in December, 1986. These activities, designed to promote professionalism among Memphis mathematics teachers and to establish linkages between mathematics teachers and other mathematics professionals in business and higher education, are described in the section

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"Collaborative Sponsored Activities." Other activities made available to mathematics teachers by other local organizations and supported by the collaborative are described in the section "Collaborative Supported Activities."

COLLABORATIVE SPONSORED ACTIVITIES

Kick-off Dinner

The Memphis Urban Mathematics Collaborative "Kick-off" Dinner was held January 30, 1987, at Rhodes College. The activity was designed to present the current status of the collaborative, to offer opportunities for teachers to meet and mingle with college professors and business personnel involved with the collaborative, and to publicize and promote the projects the collaborative will sponsor during its first year. A cocktail dinner was followed by greetings from Project Director Nancy Gates, remarks from Molly Long, Chairman of the Memphis Urban League Board; remarks by Norm Webb of the Documentation Project; and a summary of collaborative progress to date by Dr. Marshall Jones, Advisory Committee Chairman and chairman of the Mathematics Department at Rhodes College. In addition, Dr. Thomas Barr of Rhodes College spoke on discrete mathematics.

Mathematics teachers from the twenty target schools were invited, as well as mathematics professors from local colleges and universities, representatives from nearly fifty business firms in the area, and several representatives from the School Board, including the superintendent and assistant superintendent. Attendance totaled 105, including approximately fifteen business representatives.

Teachers said the event was very worthwhile. One teacher commented, "I left inspired and with new ideas and things to do." Another commented, "I met with businessmen who were really helpful. I plan to get them for future talks. I was able to get names and phone numbers of contacts for future use. I really got some good ideas." A third admitted, "I went with real misgivings as a junior high mathematics teacher. I wondered if I would get anything out of this. But after the talk, I realized that I was laying the foundation for upper-division courses. . . The whole collaborative idea sounds great! The idea of bringing real world into the classroom is great and worthwhile if we can do it."

Overall, those surveyed were very supportive of the collaborative and enthusiastic about the dinner. Teachers considered the opportunity to make contacts with business and college personnel as one of those most valuable aspects of the event. One teacher said, "I met several college professors and businessmen who were quite cordial and even invited me to visit their business for a tour of how they used statistics and

mathematics." A representative from Federal Express commented, "I am excited about the whole collaborative plan. I think there are many good projects being proposed; I hope we can all pull it off the ground."

Speakers Bureau

Based on information from a survey of potential speakers, the Speakers Bureau Subcommittee developed a roster of speakers from universities, businesses, and the school system who would be available to speak to mathematics classes or teacher groups on a variety of topics. The Speakers Bureau Directory, which was distributed in mid-February, contains biographical information on fifty-one speakers, and lists nearly seventy presentations the speakers are willing to make to classes, mathematics clubs, and mathematics teachers. The subcommittee will facilitate scheduling of presentations by making the contacts and serving as a liaison between the teachers and the speakers, and teachers are being encouraged to consider and use this resource as they develop their teaching plans. By the end of February, eight speakers had been scheduled in five schools; twelve additional requests for speakers had been made by late March.

The first speaker arranged by the subcommittee addressed more than 100 people in attendance at the Mu Alpha Theta Math Club's annual induction, held at Central High School on February 27. Dr. Tom Caplinger of Memphis State University spoke on "Math Trivia." Many favorable comments were heard from students, parents, and teachers.

Teachers have responded very favorably to the Speakers Bureau, although many felt too pressed for time during the school year to make use of it. One teacher said, "There are some great speakers and diverse topics in the directory. I really want to make use of it but it is so late in the year and I feel really pushed to finish the required topics in the curriculum guide. I plan to make more use of this service next year when I am not so hurried." Another teacher was impressed with the ease and comparative speed of the system: "It is great to see some efficiency that is designed to help the classroom teacher. We rarely see that."

Resource Associates Program

The Resource Associates Program was developed to foster one-to-one relationships between teachers and both college/university professors and mathematicians in business and industry. Initial plans called for identifying twenty industry/higher education mentors who would make a commitment to work with one or two teachers during the project year, providing

teachers with opportunities to discuss teaching techniques, curriculum activities and business-related mathematics concepts.

The Resource Associates Subcommittee distributed questionnaires to teachers, college and university professors, and mathematicians in business and industry in order to identify what the teachers hoped to gain and what the mentors had to offer. Approximately forty-three teachers and thirty-eight professionals from the community expressed an interest in the program.

On February 23, 1987, the Subcommittee met to evaluate the teacher surveys, to pair teachers with resource associates, and to set guidelines and determine the steps necessary to initiate the program. In March, teachers were contacted to determine whether they were still interested in the program; those who expressed a willingness to participate were provided with the name and office telephone number of a college or business resource associate and were instructed to contact the associate to establish projects and time schedules. Thirty-seven pairings involving forty teachers were initiated. As in the case of the Speakers' Program Bureau, teachers said they would like to make better use of the Resource Associates Program but were pressed for time during the last few weeks of the school year.

Summer Workshops

The Summer Course Committee began its work in the fall of 1986 by developing a survey to obtain feedback from teachers about workshop topics that would interest them. The committee met February 12, 1987, to plan the workshops and courses for the summer of 1987. In response to the teacher survey, the collaborative decided to offer a series of four-hour, four-day workshops designed specifically to refresh teachers' skills and to present ideas about teaching. The general topics to be covered included algebra, geometry, probability, and mathematics across the curriculum. The majority of funding was to come from Title II funds, and the remainder from MUMC.

On February 26, the Summer Course Committee met again to finalize plans and to approve the syllabi for the summer workshops. Instructors were tentatively approved.

On April 23, course descriptions were distributed to teachers in the collaborative's target schools. Enrollment was limited to twenty teachers in each course, with registration on a first-come basis. On May 8, registration was opened to teachers outside the twenty target schools, and, as of June 1, 1987, all four workshops were full, with waiting lists of as many as twenty teachers. Teachers received a $192 stipend for attending each workshop.

Mathematics Across the Curriculum Workshop. On June 15-18, a workshop focusing on practical applications of mathematics in other fields was held at the State Technical Institute. Dr. Margie Hobbs and Dr. Cheryl Cleaves provided a survey of the applications of mathematics in the high school curriculum, focusing on the use of Algebra I, Algebra II, and Geometry in Chemistry, Physics, the social sciences, and vocational education courses. Nineteen Memphis City Schools mathematics teachers attended. The workshop was well received by participants, who almost unanimously rated it a 5 on a 5-point scale. One teacher said, "I feel this workshop broadened my perspective on the use of mathematics in the technological and vocational areas, especially the use of geometry and trigonometry." Another commented, "Kids are always asking what good this (math) will do them. Even if I don't have an application readily available, I know how to research it and find applications."

Probability Workshop. On June 15-19, Dr. Marshall Jones of Rhodes College presented a workshop on probability. Nineteen mathematics teachers attended. The workshop included an introduction of intuitive probability, simple finite probability spaces, probability laws and applications, counting problems, and probability distributions. Participants were pleased with the workshop, assigning it ratings of 4s and 5s on a 5-point scale. Those present complimented Dr. Jones' teaching skills, and reported that they had found the workshop very worthwhile. The on-site observer noted that "topics were explained in such a way that all teachers (with varying backgrounds) could understand."

Geometry Workshop. On June 23-26, Dr. Tom Caplinger of Memphis State University presented a workshop on geometry. The presentation featured an overview of major topics, with concentration on: algebraic and paragraph style proofs, three-dimensional concepts and relationships (including derivations of volume and surface area formulas), transformations, and enrichment activities with paper folding, tessellations, and problem solving. Seventeen mathematics teachers attended. While there was some feeling that the workshop focused too much on the "optional" student, the teachers felt they had benefitted from the presentation. One commented, "Dr. Caplinger is very knowledgeable and personable. As far as the topics, I don't believe I could possibly introduce these topics--except tessellations--to students at my school. I was expecting more ways to motivate the average student in geometry--not the optional."

Summer Internships

The Memphis Urban Mathematics Collaborative was successful in identifying four internships to be filled by teachers during the

summer of 1987. A fifth internship was eliminated late in the planning process because of change in personnel at the local business and a concurrent reduction in the amount of money the business was willing to allocate to collaborative activities. The internships that will be provided include one with Memphis Light, Gas and Water; one with Commerce Investments Corporation; and two with the Army Corps of Engineers. As of the end of March, fourteen teachers had applied for these four positions. Interested teachers were required to fill out job application forms of the sponsoring organizations, and to participate in interviews that were initiated by the companies based on an applicants' background, interests and experience. Participating organizations selected their own intern from the pool of teachers they chose to interview: interns were paid directly by the sponsoring corporations. Following the internship program, participating teachers are expected to meet in September 1987 to discuss their experiences and to develop ways in which their experience could positively effect their teaching of mathematics.

COLLABORATIVE SUPPORTED ACTIVITIES

Teacher Initiative Grants

The Memphis Public Education Fund made Teacher Initiative Grants available to Memphis City Schools teachers to cover the costs of teacher-initiated projects designed to improve instruction, or to enhance the teaching-learning process, including fostering teachers' understanding of their subject areas. The collaborative reminded teachers that the grants also could be used to pay tuition for graduate or undergraduate classes at a college or university. Of the 230 applications processed, 149 grants were approved, including thirteen grants to MUMC mathematics teachers.

Emerging Trends in Mathematics

Emerging Trends, a conference sponsored by the Tennessee Department of Education which focused on academic challenges in mathematics, science and foreign languages, was held June 25. Although the activity was promoted by the collaborative, no more than five collaborative teachers attended. Sessions on mathematics focused on measurement and geometry in grades K-3, Project Equality in grades 7-12, advanced mathematics courses in grades 9-12, activities for applied mathematics in grades 9-12, organizations and projects for grades 5-12, and measurement geometry for grades 4-6. In addition, sessions were offered on the use of electronic gradebooks; mathematics in the legal, architectural, and engineering professions; the EQUALS program; and the Computer Software Resource Center.

F. Observations

The Memphis Urban Mathematics Collaborative experienced a very productive first year. Discussion of the progress of the collaborative will focus on four major areas: Project Management, Collaboration, Teacher Professionalism, and Mathematics Focus.

PROJECT MANAGEMENT

The Memphis Urban Mathematics Collaborative is guided by an active Advisory Committee comprised of members who are committed to the collaborative and to improving the professional lives of mathematics teachers in Memphis. This committee has succeeded in identifying activities, in getting the collaborative underway, in understanding the development process and in recognizing the need for teachers to have more power. As the school year ended, the committee began to address the issue of encouraging teachers to take initiative for their own professional growth.

The structure of the Advisory Committee provides a good mix of people from business, higher education, schools, and the Urban League. The use of subcommittees, which are responsible for planning specific collaborative activities, has helped to foster a shared sense of purpose across these various groups. The Advisory Committee encourages one form of collaboration by actively involving representatives of the different sectors in common tasks.

The collaborative administration has made adjustments during the course of its first year of operations as the responsibilities of the executive director and project director become better defined and the support needed for the many tasks is identified. In general, Nancy Gates, the project director, was assigned responsibility for the day-to-day operations of the collaborative. Herman Ewing, executive director, was responsible for interactions with the Ford Foundation and for coordinating collaborative efforts with and making needed contacts through the Urban League. Ms. Gates occupies office space in the Urban League building and receives some clerical support from the League's staff.

As the year progressed, the level of work and time required to operate a collaborative became apparent. For example, organizing the Kick-Off Dinner required a considerable amount of Ms. Gates' time. She personally contacted nearly fifty Memphis and Nashville businesses, requesting them to send representatives to the dinner. As a result, the dinner was very successful--but its success may have established a pace and a set of expectations that would be very difficult for one person to maintain. The possibility of hiring an assistant to help with the details was discussed, but the action needed to get such help was slow in coming.

will meet monthly. These meetings will facilitate collaborative administration by involving in the planning process those people who are able to make decisions necessary to acquiring appropriate administrative support for the collaborative. This executive group serves a function different from that of the Advisory Committee, which is primarily concerned with collaborative activities. It will be interesting to observe whether the adjustments made at the close of the 1986-87 school year will assist and improve collaborative operations in coming years and whether the high level of commitment to the collaborative demonstrated by all those involved will continue.

COLLABORATION

Collaboration in Memphis has assumed several forms. The Advisory Committee, as noted above, is one example of collaboration, with people from business, higher education, and the schools working together to plan activities for the collaborative and to address such key issues as increasing teacher involvement. Another form of collaboration is indicated by the efforts of representatives in business and higher education to provide resources to teachers, as demonstrated by the Speakers Bureau, the Resource Associates Program, and the summer workshops. A third form of collaboration involves the summer internships, in which teachers and representatives of business and industry work together. Through these internships, teachers have an opportunity to experience the ways mathematics is used in the world of work. One form of collaboration not yet apparent in Memphis--that among teachers--is expected to increase as teachers attend the summer workshops. The Advisory Committee is beginning to address the need to develop this form of collaboration as it discusses ways to encourage teachers to take the initiative in planning collaborative events. During its first year, the Memphis Collaborative made many contacts and formed substantial networks that will provide a solid foundation for future efforts.

TEACHER PROFESSIONALISM

Teachers in Memphis are greatly influenced by such state mandates as the career ladder program. The need to accumulate the hours that determine teachers' position on this ladder influences how teachers are willing to spend their out-of-school time. Teachers' approach to the collaborative within this context will provide a good indication of how they view teaching as a profession. Teachers, particularly those who have reached the third level and have a twelve-month contract, have expressed support of the career ladder system. Others feel the ladder is there if they want to work for it, but that the increase in benefits is not sufficient to induce them to go through all of the steps. Teachers who participate in collaborative activities that

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do not contribute hours required by the career ladder demonstrate an especially strong commitment to their profession. Teachers who work within the system so that as many collaborative activities as possible count toward the career ladder will demonstrate a different kind of empowerment.

During the past year, teachers have demonstrated some interest in improving their professional lives. They expressed strong interest in the summer workshops, and several teachers applied for and received Teacher Initiative Grants. Because several of the activities became available toward the end of the school year, many felt they had limited opportunity to take advantage of the resources provided. It is important to note that the collaborative has developed a variety of activities during its first year that have affected many teachers and have the potential of affecting many more. The collaborative is providing the opportunity for teachers to plan and to help other teachers, rather than relying exclusively on administrators for in-service activities.

MATHEMATICS FOCUS

Teachers during the 1986-87 school year have benefited from activities involving a variety of mathematics topics. The Kick-Off Dinner presentation focused on discrete mathematics. Summer workshop topics were selected based on teachers' expressed interest in their content areas. The four topics, algebra, probability, geometry, and a survey of applications of mathematics, were chosen to specifically help teachers improve their classroom experiences. The Speakers Bureau and the Resource Associates Program both provide resources that will focus on the application of mathematics and other topics that may be requested to meet specific needs.

The collaborative leadership has a strong background in mathematics and mathematics education. Both Nancy Gates and Herman Ewing have taught mathematics. The chair of the Advisory Committee, Dr. Marshall Jones, is a member of the Rhodes College Department of Mathematics. They are in a good position to ensure that collaborative activities include events that meet the mathematical needs of district teachers.

G. Next Steps

During the 1987-88 school year, the collaborative will expand its target population to include all of the approximately 345 mathematics teachers in the Memphis Public Schools.

Teacher Committee

A Teacher Committee will be appointed for the 1987-88 school year. This committee will include thirteen teachers, the project director, the on-site observer, and the mathematics consultant. The thirteen teachers will be selected from the sixty to seventy teachers who expressed interest in participating in the collaborative during the 1987-88 school year. Teachers will be selected by members of the Advisory Committee so as to assure a balance in committee membership in gender, race, and grade level being taught.

The first meeting of the committee, which will meet once every six weeks, will be in September, 1987. The Teacher Committee will serve as a conduit for information between teachers and the collaborative. The committee also will provide the opportunity for teachers from junior high schools to talk with teachers from senior high schools.

Newsletter

The collaborative will begin to publish a quarterly newsletter that will be sent to approximately 250 teachers and to businesses in the Memphis area as an appeal for their support. Initially, the collaborative will hire an editor to produce the newsletter, which will be printed by the Board of Education.

Swap Shops

Swap Shops on six topics are scheduled for the first week in December, 1987 to allow teachers who are teaching the same class to meet with one another and discuss ideas.

Workshops are planned for teachers of Algebra I, Algebra II, Advanced Mathematics, seventh and eighth grade mathematics, ninth grade Applied Mathematics, and Geometry. The ideas discussed in each workshop will be recorded and compiled in a document that will be distributed at a district in-service day scheduled January 27, 1988.

The six teachers who have been selected to lead the Swap Shops will meet with Margie Hobbs and Cheryl Cleaves on Saturday, November 14, to plan the workshops. Each leader will be paid a stipend of $50.

Algebra Workshop

The Algebra Workshop, the last of the series of four-hour, four-day workshops offered to teachers this summer, will be held at Rhodes College. Dr. Ken Williams of Rhodes College will focus on a functional approach to algebraic concepts, including linear, polynomial, rational, inverse, exponential, and logarithmic functions, and techniques in graphing and problem solving. The workshop will provide teachers with a more unified functional view of algebra.

Workshop and Conference Attendance

The collaborative will sponsor three teachers to attend the North Carolina School of Science and Mathematics (NCSSM) 1987 summer workshop. These teachers will become familiar with the pre-calculus curriculum developed at NCSSM and will be expected to lead workshops on the topic for their Memphis colleagues during the 1987-88 school year.

TERM Project

During the summer of 1987, LeMoyne-Owen College is planning to offer a five-week workshop that includes academic year follow-up and support. Project TERM (Teacher Enrichment and Reinforcement in Mathematics) is funded by the National Science Foundation and is working through the collaborative to encourage teachers to attend. The five-week workshop will include instruction in discrete mathematics and basic programming, as well as daily sessions on mathematics problem solving and mathematics applications. Projects that relate specific mathematics topics to the secondary school classroom will be initiated in the workshop and implemented as part of regular teaching assignments during the 1987-88 school year. Participants will report on the progress of the projects during one-day mini-conferences in December, 1987, and June, 1988. The workshop will carry six hours of tuition-free undergraduate credit and provide participants a stipend of $1,000. The workshop will be open to teachers who: 1) are not certified to teach mathematics, 2) did not major in mathematics on the college level, 3) have taught no more than 50 percent of the secondary curriculum, or 4) have no more than five years of mathematics teaching experience.

SUMMARY REPORT:
NEW ORLEANS MATHEMATICS COLLABORATIVE (NOMC)

by

Urban Mathematics Collaborative Documentation Project
University of Wisconsin-Madison

PURPOSE OF THIS REPORT

This report summarizes the activities of the New Orleans Mathematics Collaborative during the 1986-87 school year. The report is intended to be both factual and interpretive. The interpretations have been made in light of the long-term goal of the Ford Foundation to increase the professional status of mathematics teachers in urban school districts and the way in which the activities of the collaborative during its first year have evolved in order to reach that goal.

The information presented in this report came from the following sources: the proposal submitted by the Metropolitan Area Committee Foundation; documents and interview information provided by the project staff; monthly reports from the on-site observer; the meeting in San Francisco in October, 1986, of representatives of all of the projects; the directors' meeting held in St. Louis in January, 1987; meetings held during the annual NCTM Conference in April, 1987, in Anaheim, California; survey data provided by teachers; a retrospective interview with Barbara Nelson of the Ford Foundation; and four site visits by the staff of the Documentation Project.

NEW ORLEANS MATHEMATICS COLLABORATIVE (NOMC)

A. Purpose

As stated in the proposal submitted to the Ford Foundation, the goal of the New Orleans Mathematics Collaborative (NOMC) is to enhance the professional development of secondary school mathematics teachers in the Orleans Parish Public Schools and to enrich the teaching of mathematics by providing opportunities for teachers:

1. to become part of a network of mathematicians;
2. to work in collaboration with mathematics teachers and other mathematicians in addressing both teacher and student needs;
3. to keep abreast of developments in the fields of mathematics and teaching; and
4. to experience firsthand the ways in which mathematics is used outside the academic setting.

B. Context

New Orleans is a city of approximately 536,300. The public school system reflects the unique demographics of its inner-city residents. Due to the migration of the white population in the 1950s and 1960s, residents of the core inner city are predominantly young, poor, and black, with many families headed by single women. The sharp increase of young mothers with elementary school-age children, is a trend that is expected to continue. In fact, New Orleans' poverty rate in 1980 ranked third among large cities, with 26.4 percent of its citizens living beneath poverty level. At that time, twice as many families and children in New Orleans lived below the poverty level as in the country as a whole. Barely 50 percent of students entering public schools graduate from high school, with the highest number of dropouts in the ninth and tenth grades.

Dr. Everett J. Williams is the superintendent of the Orleans Parish Public Schools (OPPS), which is comprised of 140 schools. There are an additional 104 nonpublic schools (private and parochial) in the Orleans Parish. New Orleans has nineteen public high schools, of which seventeen are traditional, and two are "second chance" schools for potential dropouts. Three of the traditional high schools are vocational schools; the elective courses taken by students in these schools generally are concentrated in one vocational area. Students who graduate from

the vocational schools must meet the same academic standards as students from the other schools.

Fifty-seven percent of the $218.525 million budget for the public schools during 1986-87 came from state and federal funds, with the state bearing the major fiscal responsibility for primary and secondary schools. Funds from the district's three major sources--local, state, and federal governments--are all decreasing. While New Orleans residents do have one of the highest sales taxes in the nation, the majority of homeowners in New Orleans Parish pay no property taxes as a result of low home value assessments and high tax exemptions. Voters have refused to pass new levies. Major revenues for the area come from the petroleum industry and tourism.

During the 1986-87 school year, 83,601 students were enrolled in grades K-12, a decrease of 565 students over 1985-86. Of these students, approximately 86 percent were black; 9 percent were white; and 5 percent were Asian, Hispanic or American Indian. Thirty percent of the students are in families that receive Aid to Families with Dependent Children (AFDC) and are, therefore, eligible for Chapter I funds. Additionally, 73 percent are eligible for the free lunch program. The average class size is twenty-eight students in the elementary grades, and twenty-five students in the secondary grades.

In 1985-86, there were 4,507 public school teachers in the Orleans Parish, 2,604, or 59 percent, of whom were black females. There are 248 mathematics teachers in the secondary schools, which include middle (grades 6-8), junior high (grades 7-9) and senior high (grades 9-12, or 10-12). Of these mathematics teachers, more than 223 are fully certified; 186 tenured (three or more years of service); 7 temporary; and 18 are non-certified. One mathematics teacher holds a doctorate, 38 hold masters degrees plus thirty hours, 57 hold masters degrees, one has a specialist degree, and 151 hold bachelor degrees. Teaching salaries range from $16,032 for a beginning teacher with a B.A. degree to $26,210 for a teacher with a doctorate degree. The collaborative's target group includes the district's nearly 150 senior high mathematics teachers.

Students in the graduating class of 1989 and thereafter are required to take one unit each in Algebra I, Algebra II, and Geometry for graduation. These courses are offered at three levels: regular, honors, and gifted. Remedial courses include Introduction to Algebra, Consumer Mathematics, and Business Mathematics. Courses for advanced students include Trigonometry, Advanced Mathematics, Calculus and College-Level Calculus. In addition, Computer Science I and II, and College-Level Advanced-Placement Computer Science are available.

Standardized test scores have been increasing for the last three years. On the Comprehensive Test of Basic Skills (CTBS) administered in 1986-87, 73.4 percent of students scored at or above the 25th percentile.

The mean ACT score of the 1987 New Orleans public school graduating class was 12.8 percent, compared to the national average of 18.7. (The range of possible scores was 1 through 36.) Louisiana state universities, all of which have open admission, require students with ACT scores lower than 15 to take remedial mathematics at the beginning of their college careers.

C. Establishment of the Collaborative

The Metropolitan Area Committee (MAC) Foundation is the funding agent for the New Orleans collaborative. The committee is a nonprofit, citizens' action organization whose membership includes representatives of business, labor, professional, academic, and religious communities in the greater New Orleans area. MAC, founded in 1966 by a biracial group of community leaders, sponsors a wide range of civic and educational activities in New Orleans.

The MAC Education Fund, a project of the MAC Foundation, was established in December, 1985, with a grant from the Pittsburgh-based Public Education Fund. In fall, 1985, the Ford Foundation approached Dr. Norman Francis, president of Xavier University in New Orleans and chairman of the MAC Education Fund, with the idea of creating a mathematics collaborative in New Orleans. Dr. Francis noted that the Metropolitan Area Committee was in the process of establishing a local public education fund and that this would be an appropriate host agency. However, because a large staff effort would be required to initiate the local public education fund, Dr. Francis suggested that the development of a collaborative should wait until the fund was established. Individuals on the MAC Education Fund continued to gather more information about collaboratives and to stimulate interest in the project among teachers and others in the community.

After extensive discussion with several MAC members, Barbara Nelson of the Ford Foundation met in spring, 1986, with members of the MAC Education Fund board, which included representatives from local corporations, businesses, and universities. This group's willingness to commit itself to the effort was instrumental in the decision to proceed with the development of a collaborative. The MAC Foundation received a three-month planning grant of $2,500 from the Ford Foundation. A planning group was established, consisting of representatives of OPPS, the teachers' union, professors and administrators from local universities, and leaders from the business community. The involvement of a wide variety of organizations in the planning process has been a key factor in establishing community-wide ownership of the project and in expediting the implementation of the collaborative's initial activities. On August 1, the MAC Foundation submitted a proposal to the Ford Foundation for the establishment of an urban mathematics collaborative with a start-up date of September 1, 1986.

The collaborative is comprised of OPPS, the teachers' union, three universities, the Louisiana Science Centre, and six businesses and corporations. Involvement of three other universities and additional business and community organizations has been initiated. The collaborative's program is organized into three basic components: out-of-school professional activities, in-school activities, and networking.

Constance Barkley, director of the MAC Education Fund, serves as the collaborative's project director. Olympia Boucree, a former mathematics teacher and mathematics supervisor for the Orleans Parish Schools, is project coordinator. Sally Hayes, executive director of MAC, also provided important administrative support. The on-site observer is Aldonia Winn, a former mathematics teacher who in January, 1987, became a Chapter I resource teacher.

The collaborative is governed by a Steering Committee of twenty members, including mathematics teachers, school system administrators, and representatives from the teachers' union, local businesses, universities, and the Louisiana Science Centre. Dr. Richard Hays who chaired the Steering Committee in 1986-87, also served on the MAC Education Fund Board. The Steering Committee, which meets quarterly, monitors and evaluates programs, and serves as a think tank to solve problems and create new initiatives. Four subcommittees oversee the activity areas: symposia; site visits and internships (including university courses); workshops; and the newsletter. Each subcommittee is responsible for implementing appropriate programs, recommending modifications based on program experiences, and generating ideas for new collaborative activities.

The symposia subcommittee planned and evaluated symposia in December and April. The workshop subcommittee plans workshops to which all mathematics teachers in the New Orleans public schools are invited. The site visit/internship subcommittee contacts companies, universities, and other institutions for a commitment to host site visits, sponsor an intern, and/or visit a New Orleans public school. The newsletter subcommittee is composed of designated newsletter coordinators from the other three subcommittees. Two issues of the New Orleans Mathematics Collaborative Newsletter were published in the 1986-87 school year, with the first edition appearing in January, 1987.

At the Steering Committee meeting on February 9, 1987, Dr. Mark Driscoll, director of the UMC Technical Assistance Project at the Education Development Center, shared information from other collaboratives and discussed the January 15-16 Mathematics Symposium in Washington, D.C. Dr. Driscoll emphasized the role of EDC in helping the NOMC in its endeavors and also expressed his view that current problems in mathematics education stem not from the quality of teaching, but from fundamental problems in the curriculum. He stressed the need to consider mathematics as a viable, dynamic body of knowledge and explained that site visits to industry could provide teachers an opportunity to view mathematics from different perspectives. The subcommittees in charge of

symposia, site visits, workshops, and the newsletter reported on their activities, and Constance Barkley reported on mini-grants.

At the May 18 Steering Committee meeting, at the Liberty Bank, the teacher evaluations of the first year of the collaborative, given at a May 11 meeting, were discussed. As at the other Steering Committee meetings, Richard Hays led the discussion. The values of the different type of activities--site visits, symposiums, and workshops--were discussed and a draft of the second year proposal was outlined. Committee members decided they did not want to make any drastic changes in the proposal and suggested that the staff from MAC should go ahead and write the proposal with input from teachers. On June 15, the Steering Committee met to review the proposal for continued funding, to be submitted to the Ford Foundation, which was prepared by the MAC staff. The proposal was approved.

D. Relationship with Other Local Initiatives

Resources available to the collaborative include the Louisiana Science Centre; the nationwide network of Ford Foundation-supported urban mathematics collaboratives; professional organizations in mathematics-related fields, including the MAC Education Fund; and the local Council of Teachers of Mathematics. An effort is being made to maintain a high community profile through effective use of the media, the collaborative newsletter, and business, university, and school-system publications.

The MAC Education Fund, developed in 1985, is a project of MAC. The New Orleans Mathematics Collaborative is the fourth program to be coordinated by the MAC Education Fund. The other current programs of the education fund are "Partnerships in Education," "Mini-Grants for Teachers," and "Community Awareness."

The Partnerships in Education program provides an opportunity for business- and private-sector organizations to become involved in public education through concentration on the needs of an individual school. Through these partnerships, schools expand their available resources and enhance their understanding of the needs and concerns of business. During the summer of 1986, five teachers were guests of the U.S. Army in a visit to Fort Sill, Oklahoma, where they observed the mathematics the Army was using. Another outcome from the Partnerships program is that some teachers received mini-grants from the business partner for their schools.

The mini-grant program provides teachers with the resources to explore new teaching techniques and to develop creative projects to benefit their students. Grants of up to $500 per teacher are awarded in the fall and spring semesters, with an implementation period of up to twelve months. During the 1986-87 school year, $10,000 was reserved for mathematics projects.

The MAC Education Fund's community awareness program is designed to improve citizen awareness of the needs of and the challenges facing the New Orleans public schools. The program is sorely needed in New Orleans, where 80 percent of the city's households have little or no contact with the public schools because of a combination of factors, including children attending private or Catholic schools and parents who don't get involved in their children's education. The isolation of citizens from the schools is reflected in the confusion which surrounds many public-school issues. For example, the public schools' lack of a constituency has meant that recent tax levies on the ballot have all failed to pass.

The newly established Louisiana Science Centre has been very supportive of the collaborative. The Centre, originally established by the New Orleans Chamber of Commerce as a project of the business community, is designed to teach basic science and mathematics to the public through thematic exhibits, coursework, and daily classes. At the end of the 1986-87 school year, the Centre was negotiating with the city and the Port of Orleans for a building located on the banks of the Mississippi River in the area of the 1983 World's Fair. During the year, the small staff of three or four operated out of temporary quarters. Because much of the Centre's staff time during the year was devoted to attaining a lease at a new Centre site, the staff was unable to fulfill its plan to provide some workshops for mathematics teachers.

E. Project Activities

During the 1986-87 school year, the New Orleans Mathematics Collaborative sponsored a variety of activities to provide teachers the opportunity to form networks with their peers, to keep abreast of developments in the fields of mathematics and teaching, to work collaboratively with other teachers and mathematicians and to experience firsthand the ways in which mathematics is used outside the academic setting. These activities are described in the section "Collaborative Sponsored Activities."

The collaborative also encouraged teachers to participate in the Mini-grant Program sponsored by the Education Fund of the Metropolitan Area Committee and in a workshop the collaborative co-hosted with Loyola University. These activities are described in the section "Collaborative Supported Activities."

COLLABORATIVE SPONSORED ACTIVITIES

Opening Reception

A reception to officially launch the New Orleans Mathematics Collaborative was held November 18, 1986, at the Louisiana Science Centre in the Cenote of Sacrifice exhibit. This was a temporary exhibit erected in rental space to provide the public with an idea of what the Science Centre may do. The Science Centre provided the space and the collaborative paid for the food. Teachers, principals and school district personnel were invited, along with the media and key representatives of the New Orleans business and university communities. Between forty and fifty people attended, including teachers, principals and other school administrators, and representatives of businesses, universities and community groups.

Symposia

On December 4, 1986, NOMC sponsored its kick-off symposium, "Mathematics for All," at the Holiday Inn Crowne Plaza. Dr. Jack Cawley, professor of mathematics at the University of New Orleans, spoke on the use of mathematics. A panel discussion involving Merle Harris, a teacher, and Jonathan Lifa of Chevron U.S.A., followed the presentation. Attendance was very good: of the 118 persons who made reservations, 106 attended. Approximately 75 percent were teachers; the remainder were representatives from businesses and universities. Seventy-four participants evaluated the symposium; respondents included forty-six teachers, twelve business representatives, seven university professors, and nine administrators. The overall evaluation was very positive. One person wrote, "We need more gatherings like this so that math teachers and business people can discuss educational issues that are of mutual interest to both groups. The discussion segment allows teachers to focus on specific mathematical needs and concerns of the business sector." Another noted, "Long overdue." A third participant observed that the symposium was "refreshing and informative."

The second symposium was held April 23, 1987, at the Plimsoll Club in New Orleans. Dr. Ross Finney, senior lecturer in Mathematics at MIT, spoke on "Professional Applications of Precalculus Mathematics." Dr. Finney focused on mathematical modeling and used several intriguing examples such as card tricks and legislative turnover to motivate the creation of mathematical models using linear algebra, logarithmic and exponential functions, and probability and statistics. After dinner, Dr. Matthew Proctor, Deputy Superintendent of the Orleans Parish Public Schools, spoke, and Brian Decuir, a teacher at McDonough 35 Senior High School, and Michael Grumich, Senior Analyst at Louisiana Power and Light/New Orleans Public Service, Inc., responded. Approximately eighty

teachers and thirty-three business and university representatives, as well as several administrators from OPPS, attended the symposium.

Sixteen of the seventeen target high schools were represented at the symposia, which were viewed as having been very successful.

Department Chairs' Meeting

A meeting of all mathematics department chairpersons from the OPPS senior high schools of the New Orleans Parish Schools was held January 8, 1987, at the Lakeview Administrative Center to inform department chairpersons about NOMC and the role of the on-site observer. The activity was organized by Marie Kaigler, the Mathematics Specialist for the Orleans Parish Public Schools. Seventeen mathematics department chairpersons attended and heard a presentation by Dr. Olympia Boucree, the project coordinator. At the meeting teacher surveys were distributed and the procedures for having teachers complete the surveys and return them were discussed.

Site Visits

The New Orleans Mathematics Collaborative arranged four site visits to businesses and industries during the 1986-87 school year. OPPS provided release time so teachers could participate and acquire practical information to apply to their classroom teaching. Olympia Boucree contacted each business that agreed to have a site visit and told them of what the collaborative expected from the visit. The businesses then planned the agenda and activities for the day, including lunch for the teachers. While approximately fifty-five teachers expressed interest in participating in a site visit, there was space for only twenty-eight. The mathematics department chairs at each of the seventeen senior high schools and at the ten junior high schools were asked to designate a teacher from each school to attend one of the site visits. A total of twenty-two teachers actually were able to take advantage of this activity.

New Orleans Public Service Site Visit. On March 11, 1987, six teachers from the Orleans Parish Public School participated in a one-day visit to New Orleans Public Service Inc. (NOPSI) and Louisiana Power and Light (LP&L). The teachers heard presentations on load research, system planning, forecasting, and marketing, and also toured the Skills Center, where engineers and maintenance personnel responsible for the nuclear facility are trained. The visit included a discussion of mathematics training needed by employees and the ways in which mathematics is used in the public utilities industry. The high quality of the program's visual

materials prompted teachers to discuss how they could emulate the visual presentations in their classrooms. They received materials, graphics, and outlines which could be duplicated for classroom use. One teacher observed, "Everything presented today was very enjoyable. Each presenter left me with several ways of alerting my students about the need to pursue their math studies." The teachers' only negative comments involved the lack of time and the distance they had to travel to visit the facilities (a one-hour drive each way)--both circumstances they realized couldn't be helped.

One teacher, who wrote her impressions of the site visit in an article which appeared in the second edition of the NOMC Newsletter, said, "I was amazed at the range of mathematics topics used. Employees used knowledge from Math I to Trigonometry and Calculus. The speakers emphasized to us that rote knowledge alone is not good enough. The speakers said, 'They have computers for rote knowledge. An employee must know how to interpret mathematical results.'" The teacher also observed that the list of mathematics skills taught and used at Waterford 3, the nuclear facility, resembled the Expected Learner Outcomes which are minimum Learner objectives established by the Parish within guidelines from the state.

Michael Grumich, Senior Analyst for LP&L and NOPSI, also commented on the site visit in the same issue of the newsletter. He wrote, "The employees of LP&L and NOPSI who were involved in the program for the visiting teachers commented positively on having the opportunity to share the mathematical skills and tools of the work place. Everyone remembers studying mathematics in high school and not being able to fully understand how the pieces fit into the bigger picture of the real world. The true appreciation of the integral nature of mathematics within the engineering discipline and all other technical fields comes with many years of practical applications. Presentations to visiting teachers provided a reappreciation of the logical and mathematical processes utilized daily in carrying out the responsibility to provide dependable electrical service to the customers."

Shell Offshore Site Visit. A site visit to Shell Offshore Incorporated was held March 19, 1987. Five high school mathematics teachers and the on-site observer heard presentations on the use of mathematics in the oil industry. Topics included, "Well Design and Directional Surveys," "Geological Data Base," "Probability and Decision Trees," "Well Testing," "Seismic Exploration," "Data Processing," "Interpretation," and "3D Workstation." Shell provided lunch for the group.

The program was extremely well received. One teacher commented, "Presentations were excellent and related job an job requirements to the type of mathematics at higher levels, but based on the foundation of courses in high school." Another teacher stated that the program was "worth my time and my students' time."

A third said, "Presenters were courteous, personable and a pleasure to be around. They provided a peer-to-peer relationship rather than one that was superior." One teacher summarized his comments by saying, "Basically, I can only praise Mobil Oil for its effort."

Freeport-McMoRan Site Visit. A site visit to Freeport-McMoRan, Inc., a worldwide corporation comprised of companies ranging from mining to manufacturing, was held March 25, 1987. Five mathematics teachers, each from a different junior high school, heard presentations on the use of the mathematics taught in junior high schools in the business world. The teachers who attended were very pleased with the visit and found it both informative and interesting. One teacher said, "I came to a company about which I knew very little and learned a great deal to take back to my school." A second noted, "The visit was well organized. The jobs discussed covered all levels of math from basic and general concepts to the higher levels of math." All five teachers felt that they could relate the mathematics applications they had observed to the mathematics curriculum. As one teacher said, "The mathematics models were practical and should be easy to present to students."

Consolidated Natural Gas Site Visit. A site visit to the Consolidated Natural Gas Company on April 13, 1987, offered five teachers several examples of how basic mathematics is used in accounting, and how applied and finite mathematics are used in engineering. The program consisted of lectures and did not include tours or hands-on experience, which most teachers later indicated that they would have preferred. The discussion included examples from trigonometry, geometry, basic mathematics, algebra, physics, accounting, and calculus. Teachers noted that none of the speakers were women or minorities.

Workshops

The New Orleans Mathematics Collaborative conducted three of the Orleans Parish Public Schools' mandated workshops during the 1986-87 school year. Twenty-six teachers participated in these workshops.

Problem Solving Workshop. An in-service workshop on problem solving sponsored by OPPS Staff Development was held February 19, 1987, at Kennedy Senior High School. Eight teachers attended. Dr. Yvelyne Germaine-McCarthy, a mathematics teacher at Benjamin Franklin, presented material on problem solving. The material was generally well received. One teacher commented that the presentation was "thought provoking and had everyone involved." Another said, "Most OPPS workshops are a waste of time--a repeat of what I know. This is the first one I can actually say that I

learned a lot from. Keep up the good work!" A third teacher stated, "What a delightful way to learn and/or review!" This workshop was arranged by the district on one of its mandatory in-service days. By request of the mathematics supervisor, the collaborative identified the topic, planned and arranged for the speaker and promoted and advertised the activity. The workshop topic was culled from evaluation forms collected at the collaborative symposium.

Any teacher in the school system could attend any of the scheduled workshops on that day. Consequently, some elementary teachers attended, and felt that the material was too advanced for their needs, but believed that some of the handouts could be adapted. One teacher suggested that the planners should "check the grade level of the participants and gear the problems to it."

Mathematics Anxiety Workshop. The collaborative arranged for a speaker and advertised an in-service workshop on mathematics anxiety held February 20, 1987, at Kohn Jr. High School. Dr. Joanie Steinberg, a professor at Tulane University, presented materials on mathematics anxiety to ten teachers. The attendance was lower than anticipated. Participants were very involved and seemed to enjoy themselves.

Using Computers and Calculators in the Classroom. On May 2, 1987, the collaborative sponsored a three-hour Saturday workshop on the use of calculators and computers in the classroom, directed by Dr. Antonio Lopez of Loyola University. While there was space in the workshop for thirty participants, only eight actually attended. This was the Saturday following the Thursday night symposium. All teachers were invited to attend the workshop, but because of its closeness in time to the symposium, the attendance was lower than expected.

The collaborative's Steering Committee recognized that the workshops were less popular among teachers than other NOMC activities. It also is aware of the need to determine those topics that are of most interest to teachers. In addition, the teachers suggested that perhaps the sessions would be more appealing if they were not called workshops, but instead promoted as "seminars" or "mini-courses."

Teacher Evaluation Meeting

On May 11, 1987, the NOMC sponsored a meeting at the Liberty Bank to allow teachers an opportunity to evaluate the first year of the collaborative. All mathematics teachers were invited. Eleven district teachers attended, as well as three from MAC (Olympia Boucree, Constance Barkley, and Sally Hayes), and two representatives from the Steering Committee (Richard Hays and Ron

Masters). The teachers commented on those aspects of the collaborative they appreciated and made suggestions for changes and improvements. Teachers stressed that they need to meet with people from business and universities to hear about what will be expected of students graduating from high school. The group recommended that the symposium should be continued, but that the topics should have a wider appeal. The site visits should include more teachers and the teachers who attend should share the information received with other teachers and students in their school. The workshops should be referred to by some other name. Teachers should meet to formulate a cohesive policy statement about "where we are as math teachers" rather than attend workshops. One action taken by the collaborative, based on the reactions of teachers at the meeting, was to form a Teacher Advisory Council beginning in the fall, 1987.

Collaborative Newsletter

Two issues of the New Orleans Mathematics Collaborative Newsletter were distributed to approximately 150 mathematics teachers in the New Orleans public secondary schools during the 1986-87 school year. The Newsletter announced upcoming events, reported on past collaborative activities, and served as a vehicle for teachers and business representatives to express their views on collaboration. In 1986-87, the Newsletter was edited by Merle Harris, who originally chaired the Newsletter Committee. At the end of the school year, with Ms. Harris leaving the district, Ella Butler was appointed as the new editor. Ms. Butler is a mathematics teacher at Rabouin Vocational High School.

COLLABORATIVE SUPPORTED ACTIVITIES

Mini-grants

The collaborative encouraged and supported teachers to make use of the Mini-grant Program of the Metropolitan Area Committee Education Fund. In the 1986-87 school year, $10,000 was reserved to fund mathematics-related projects at all grade levels. During the first round, six mini-grants totaling $2,793 were awarded to teachers in the New Orleans public schools for mathematics-related projects. A total of 330 proposals were submitted by teachers from all content areas. One criteria required that the proposed project was innovative. Ella Butler, a teacher at Rabouin Vocational High School, is using her $500 mini-grant to teach students mathematics in a way which will directly relate what they learn from their textbook to the mathematics they will use in future jobs. She will also give students opportunities to learn about mathematics-related careers. Willie Hampton, a teacher at Booker T. Washington High School, is using his $500 mini-grant to establish a Mathematics

Applications Room to be used by all teachers and students on a rotating basis. Teachers will bring their classes to the room to acquire hands-on experience in mathematical concepts. Four other mini-grants were awarded to elementary school teachers for projects related to manipulatives, working with parents on problem solving, improving students' logical thinking skills, and using mathematics in a small business.

Two hundred applications from all content area teachers have been received for the second round of mini-grant awards, which will be announced in July, 1987.

Reception and Lecture

On Monday, April 13, the collaborative and the Department of Mathematical Sciences of Loyola University co-hosted a reception and a lecture by Dr. C. C. Rousseau of Memphis State University. Dr. Rousseau, who coaches teams for the International Mathematical Olympiad, lectured on the competition and presented some of the Olympiad problems. Because of excessive rain, nobody from the collaborative attended.

F. Observations

During its first year, the New Orleans Mathematics Collaborative implemented a number of activities and established its organizational administration. Discussion of the collaborative's growth during the year is organized into four sections: Project Management, Collaboration, Professionalism, and Mathematics Focus.

PROJECT MANAGEMENT

The collaborative's direction is provided by the Steering Committee, which meets regularly and has been actively involved in preparing the original and refunding proposals. The daily operations of the collaborative are overseen by the director, Constance Barkley, and the coordinator, Olympia Boucree. Sally Hayes, Executive Vice President of MAC, was very involved in the collaborative during its first year and contributed her leadership and experience when needed. These three administrators had adjacent office space, which facilitated communication among them. During the year, the three moved to a larger area in another part of the FNBC Building. As a result, more room was available for the general operations of the MAC and the collaborative at the same time these collaborative leaders will be able to maintain adjacent offices.

The director and coordinator of the collaborative share a vision of the collaborative's progression over the next five years. They see the collaborative developing in stages, from an initial recog ition stage where teachers become comfortable with the collaborative, to a developmen stage where teachers struggle to take control of making change happen, and finally to a change stage where there has been actual changes in what teachers do.

Because of the depressed economy in New Orleans and in Louisiana in general, fund raising has been very difficult. The collaborative, however, succeeded in attaining commitments for the funds necessary for the next two-year proposal to the Ford Foundation. The funds came from the school district (22 percent), universities (17 Percent), businesses (48 percent), and other organizations (13 percent). The collaborative's goal is that over these next two years, the project's demonstrable outcomes will be sufficient to convince an increasing number of local groups of the project's viability to the extent that they will be willing to contribute to its financial support. Concurrently, another collaborative strategy encourages teachers, business people, and academicians to interact professionally in order to engender in them a sense of responsibility for their own networking and professional relationships.

The New Orleans collaborative has accomplished its first year goal of developing community awareness of its existence. Nearly two-thirds of local public school teachers participated in one or more of the collaborative's activities, and the project successfully fostered the meaningful involvement of representatives from all sectors. As the collaborative enters its second year, it must expand its sphere of influence among teachers and increase the degree of participation of people from business and higher education. When Sally Hayes leaves MAC in September, 1987, some of her responsibilities will be assumed by the project director; in addition, the director will assume increasing leadership responsibilities related to the MAC Education Fund. As a result, the degree of close attention that the director will be able to devote to the collaborative is questionable. Perhaps the durability of an organization is most tested when there is a change in key people. This is to be observed over the next yea in New Orleans.

COLLABORATION

Collaboration is happening in New Orleans. People in all sectors have been very active in planning and attending activities. The Steering Committee, composed of representatives from business, higher education, and schools, has fostered a high level of collaboration, with all participants serving as equals. Decisions are made by the subcommittees and the larger group. The influence of the combined efforts was evident at the symposium; there was a large attendance of those from outside of education and at least

one person from each sector participated in the program. Participation of school district administrators is also noteworthy. The superintendent of schools, or his representative, attended each of the two symposiums sponsored by the collaborative. Furthermore, Marie Kaigler, the district's mathematics supervisor, is very active in planning and participating in collaborative events.

Those in higher education and business who have worked with the collaborative are very committed to helping improve the New Orleans educational system. Teachers and representatives from business and higher education are all very much aware of the condition of education in New Orleans and its reputation both locally and nationally. They see that the improvement of education will mean an overall improvement in the economic and social conditions of the region. Therefore, several very dedicated people are working with the collaborative to make change happen. One engineer who recently moved to the area from California became involved because he observed the positive effect business involvement could have on minority student achievement through their participation in MESA, the Mathematics, Engineering, and Science Association. Another former mathematics teacher who is currently working for a local corporation explained that it was "good business to have a strong public education system, so that people from out of state can be attracted to work in New Orleans." An economics professor at the University of New Orleans wrote, "Metro areas with spirited, enterprising leadership are generally those with well-managed and adequately funded school systems. The delivery of the government service of public education is an enterprise which requires broad community participation and the highest calibre of management." The Steering Committee observed in working with businesses and companies that the greatest help and participation came from individuals usually at the middle management or technical level, rather than at the level of the chief executive officer.

Another form of collaboration apparent in the first year of the New Orleans collaborative is the role of business representatives and university professors as resources. This is most evident in the site visits and the workshops, where business people and university professors have talked about applications in mathematics, problem solving, calculators, and computers.

NOMC teachers, particularly those serving on the Steering subcommittees, have also worked cooperatively. The symposia have provided teachers with an opportunity to meet and become better acquainted. Some local mathematics teachers are also very active in the Louisiana Council of Teachers of Mathematics, while others are active in union and political affairs. For example, this past year, several teachers participated in a Baton Rouge rally in support of more state funding of education.

Teachers will have more of an opportunity for collaboration as the Teacher Advisory Council is formed and becomes active. As evidenced by the experience of the other collaboratives, such a

group generally develops a sense of cohension and sharing that can be very meaningful to participants. The TAC has the potential of establishing a core of teachers from which significant collaboration among teachers can be built. Issues to be considered with the growth of the TAC include whether to rotate membership, and how to offer this positive experience to a wider group of teachers.

Some forms of collaboration envisioned in the original proposal have not evolved. One such relationship that has been slow to develop is that between the Louisiana Science Centre and the NOMC. The Centre has experienced problems in establishing permanent space as a result of a bureaucratic entanglement between the City and the Port of New Orleans regarding ownership of the site. Centre representatives have participated in collaborative activities and are very supportive of the project's efforts. It is hoped that the Centre will become more directly useful when it becomes situated.

Four of the twelve businesses contacted this year to host an on-site visit agreed to participate. The remaining eight companies contacted generally offered a good reason for their refusal, but expressed interest in involvement in the near future. This response offers encouragement for the collaborative's efforts to expand the number of businesses that eventually will be involved. It remains a challenge to the collaborative as to how best to use these resources so that teachers as well as the companies garner the greatest benefit.

PROFESSIONALISM

Many mathematics teachers in New Orleans are very much interested in improving local education. Teachers also appear to be interested in gaining new insights into teaching mathematics and into developing better ways of teaching various topics. Some aspects of the system, however, do not encourage professional development. For example, benefits are not necessarily commensurate with the costs of certification. A mathematics teacher who teaches computer science courses found the cost of taking fifteen credits to earn a certificate in computer science would exceed any benefit she would receive; such advancement would not have increased her pay benefits. Even though this teacher is interested in knowing more about computer science, she works during the summer rather than taking courses.

Although some local organizations do encourage teachers to assemble together outside of school (such as at the New Orleans Council of Teachers of Mathematics meetings three times a year, the union meetings, and department head meetings at least once a year), the collaborative's programs and leadership have made it more inviting for teachers to congregate. The number of teachers who have attended the collaborative symposia offers a solid indication

of the interest of teachers and their willingness to participate in professional activities. In addition to providing the opportunity for teachers to talk with one another, the collaborative's mini-grants provide funds to allow teachers to try some creative ideas in their classrooms, and its free workshops enable teachers to learn more about such topics as discrete mathematics and the use of computers to teach mathematics.

The collaborative plans to increase the role of teachers in its decision-making process by forming a Teacher Advisory Council. This will increase teachers' involvement and allow them greater influence in developing and implementing the collaborative's activities and focus.

MATHEMATICS FOCUS

A major issue facing New Orleans teachers is a new state requirement that takes effect in 1989 that all students must have passed Algebra I and II and Geometry to graduate from high school. A concern that students do not have the prerequistes to do algebra has prompted one school to offer some ninth-grade students two mathematics classes back to back, the first in computational skills and the second in algebra.

Within the context of state requirements, New Orleans high schools differ slightly in what mathematics is offered and how the mathematics program is structured. One school, for example, has expressed interest in an integrated mathematics curriculum. In about a third of the seventeen high schools, the mathematics program includes a calculus and advanced mathematics courses. These generally are schools with some special designation, such as those with a gifted-and-talented program or a magnet program.

The collaborative's approach during its first year of operations has involved offering different activities with a variety of purposes. Thus, teachers have been offered the opportunity to attend workshops on problem solving, a symposium on applications of mathematics, and site visits to observe how mathematics is being used in industry. Many activities were designed to raise teachers' awareness levels about different uses of mathematics. The collaborative has noted that greater detail is necessary if teachers are to know more about what mathematical content is important to students today and how mathematics is being used in the workplace. One collaborative strategy has focused on forming a network of mathematics-using professionals. As the collaborative progresses, it will document the extent to which activities surpass merely providing general mathematics information to the point that teachers become more knowledgeable so that this new expertise is reflected in their teaching.

Internships

There will be no internships in the summer of 1987. Three business internships and one teaching assistantship at a university are planned for the summer of 1988 as a pilot that may be expanded in future years.

Workshops

Some workshops will be held during the 1987-88 school year. The format of these will be different from those conducted in previous years. Although the workshops during 1986-87 were not well attended, teachers expressed interest in modified versions of them. If the Louisiana Science Centre acquires permanent space, the possibility exists that the Centre will assume some responsibility for conducting workshops.

Mini-grants

In 1987-88, the MAC Education Fund will reserve $10,000 to award to mathematics-related grants for innovative classroom projects in grades 1-12. It is anticipated that a booklet outlining the mathematics grants awarded will be published in December, 1987.

Mathematics Symposia

Three symposia will be held during the 1987-88 school year, including a reception marking the one-year anniversary of the New Orleans Mathematics Collaborative. The symposia will be planned to provide an informal atmosphere in which teachers can interact with one another and with colleagues from businesses and the universities.

Newsletter

The collaborative newsletter will continue to be published and distributed to collaborative members. It is hoped that the newsletter will become a forum for the exchange of ideas and information.

SUMMARY REPORT:
PHILADELPHIA MATH SCIENCE COLLABORATIVE

by

Urban Mathematics Collaborative Documentation Project
University of Wisconsin-Madison

PURPOSE OF THIS REPORT

This report summarizes the efforts of the Philadelphia Math Science Collaborative on behalf of mathematics teachers during the 1986-87 school year. The report is intended to be both factual and interpretive. The interpretations have been made in light of the long-term goal of the Ford Foundation to increase the professional status of mathematics teachers in urban school districts and the way in which the activities of the collaborative during the past year have evolved in order to reach that goal.

The information presented in this report came from the following sources: the proposal submitted by the Philadelphia Math Science Collaborative to the Ford Foundation for the continued funding of the collaborative; documents provided by the project staff; monthly reports from the on-site observer; the meeting in San Francisco in October, 1986, of representatives of all of the projects; the directors' meeting held in St. Louis in January, 1987; meetings held during the annual NCTM Conference in April, 1987, in Anaheim, California; survey data provided by teachers; and three site visits by the staff of the Documentation Project.

PHILADELPHIA MATH SCIENCE COLLABORATIVE

A. Purpose

A primary purpose of the Philadelphia Math Science Collaborative is to promote teacher leadership and team building, and to contribute to an understanding of a vision of mathematics teaching for the future. These activities are viewed as an initial step toward the goals of promoting change and empowering teachers to make needed changes.

The specific goals of the Philadelphia Math Science Collaborative are:

1. to develop, evaluate and document the position of an in-school collaborator who would be responsible for increasing communication among teachers, including across disciplines, and for serving as a catalyst for innovation and change;

2. to increase teacher participation in extramural professional development programs which offer:

 a. partnerships between teachers and their colleagues in academia and industry;

 b. opportunities to enhance and improve knowledge, skills and professionalism; and

 c. new ideas and opportunities for mathematics instruction, including integration of mathematics and the sciences, and use of calculators and computers to teach mathematics and science; and

3. to develop a model for documenting and evaluating the impact of both the in-school mathematics collaborator's activities and teacher participation in extramural programs on the quality of teachers' professional lives, with close attention to the role of teachers as leaders and problem solvers.

B. Context

The School District of Philadelphia is a large urban district, with a total enrollment of approximately 198,000 students, 73 percent of whom are members of a racial minority. A significant number of these students come from families who live at or below the poverty level or who are otherwise socially disadvantaged.

In September, 1986, Dr. Constance E. Clayton began her fourth year as superintendent of the School District of Philadelphia. She reported that during the past three years, equal educational opportunities have been provided to all students through a balanced and focused curriculum. She also said that her administration has succeeded in balancing the district budget and in increasing the confidence that parents and financial, corporate, and educational communities have exhibited toward the schools. Dr. Clayton supports the "Focus On Instruction" as the district's major initiative for the 1986-87 school year. This initiative will provide the framework for a number of projects to improve the school district's instructional program.

A special effort to eliminate teacher shortages in special areas, including mathematics, was begun during the 1986-87 school year. Fourteen nonteaching district employees (classroom aides, secretaries, nonteaching assistants, and stock clerks) were given classroom positions after completing a professional certification program. To be eligible for this program, noninstructional employees must have a bachelor's degree from an accredited college or university; enroll in a professional certification program at their own expense; take at least two semester hours each year toward completion of certification requirements; and apply for an emergency or interim certificate.

The school district continues to use a mandated mathematics curriculum and a systemwide student-promotion program. The secondary-mathematics-course documents were revised during the 1985-86 school year and were given to teachers in the fall of 1986. Standard secondary mathematics courses are General Mathematics I and II, Algebra 1 and II, Geometry, Mathematics in Application, Elementary Functions, and Calculus. Marking guidelines for the promotion program recommend that final grades be based: 60 percent on teacher-made tests, 10 percent on city-wide midterm and final examinations, 15 percent on classwork, and 15 percent on homework assignments. A student should master at least 80 percent of the course objectives taught during the marking period to receive an "A" or "B." In conjunction with the new promotion policy, the school district offered summer school to freshmen, sophomores and juniors in 1986 for the first time in 17 years; prior to 1986, the summer school program was restricted to seniors. Of the 9,000 students in grades 9 through 12 who attended summer school, two-thirds were promoted because of successful course completion. Thus, as standards increase in the three-year phase-in of the systemwide promotion program, summer school has contributed to student success in such a way that the retention rate has remained constant.

The Secondary School Mathematics Curriculum Committee (SSMCC) plays a major role in specifying the mathematics curriculum in Philadelphia. The committee meets four times each year, although its working subcommittees meet more frequently; it is comprised of administrators, instructional leaders, mathematics teachers and mathematics educators concerned with the mathematics programs in

grades 7-12 in the School District of Philadelphia. The committee reviews programmatic conditions and makes recommendations concerning program generation or program modifications (i.e., content, objectives, instructional support, articulation between or among courses/program, and document format). It is in this manner that local district curriculum is shaped.

A wide array of programs is available to teachers in Philadelphia. They include those sponsored by the Philadelphia Renaissance in Science and Mathematics (PRISM), The Association of Teachers of Mathematics of Philadelphia and Vicinity (ATMOPAV), and several area colleges and universities. In addition, the Division of Mathematics of the School District of Philadelphia sponsors a number of activities and coordinates activities developed by others. Mathematics teachers, however, have not always taken advantage of these opportunities.

C. Development of the Collaborative

The collaborative was originally established in February, 1985, under the name Philadelphia Mathematics Collaborative (PMC). During the 1985-86 school year, it became clear that the PMC's two main problems were hampering the growth of the collaborative. The first was conceptual: On what basis could the collaborative establish a program of activities within the context of the rich array of opportunities already available to mathematics teachers in Philadelphia? Many of the activities initiated by the urban mathematics collaboratives in other cities already were available to Philadelphia teachers through other organizations. The second problem was managerial. The collaborative needed a coordinator with the energy and the vision to establish a reasonable program of activities. Furthermore, since The Franklin Institute is strong in science rather than in mathematics, conceptual help with respect to mathematics also was needed. However, budget constraints and the Institute's salary schedule prohibited hiring a project coordinator who would have all the necessary qualifications.

In order to address these problems, it was agreed with the Ford Foundation that the project should be restructured: (1) the collaborative would focus its efforts on a targeted number of schools; (2) the proposal for continued funding would address ways that the collaborative would relate to the other activities already available in Philadelphia; and, to coincide with the emphases of PRISM, (3) the collaborative would encompass science as well as mathematics. In fall, 1986, the Philadelphia Mathematics Collaborative was renamed the Philadelphia Math Science Collaborative. Dr. Wayne Ransom continued as the director of the restructured math/science collaborative.

Ms. Sue Stetzer assumed the coordinator's position on October 1, 1986. An experienced mathematics teacher and department head in the Philadelphia district, Ms. Stetzer is well known to

teachers and administrators. She has been active in ATMOPAV and in the collaborative. Until her appointment as coordinator, Ms. Stetzer was the on-site observer of the collaborative for the UMC Documentation Project; that position was then filled by Ms. Joyce Neff, a high school mathematics teacher in the Philadelphia schools.

The collaborative now sits within the PRISM structure. PRISM is itself a component of the Committee to Support Philadelphia Public Schools (CSPPS). The Philadelphia Alliance for Teaching Humanities in the Schools (PATHS), also a component of CSPPS, works with PRISM in administering some programs.

The collaborative's Advisory Council was formed in fall, 1986, replacing the Administrative Coordinating Committee that had existed during the first year of the collaborative project. The Advisory Council is comprised of six teachers representing the six target schools, the directors of Mathematics and of Science representing the school district, Dr. Francis Betts and Elizabeth Haslam of PRISM, Joyce Neff representing ATMOPAV, Dr. Alex Tobin representing the Philadelphia Regional Introduction for Minorities to Engineering (PRIME) program, and representatives of the Philadelphia Secondary Science Association, Drexel University, the Society for Industrial and Applied Mathematics (SIAM), Philadelphia Community College, PECO (the Philadelphia Electric Company), Sun Oil, and Philadelphia Federation of Teachers. The council's purpose is to provide support to the coordinator and direction for the collaborative by helping to evaluate and reshape existing programs, as well as by designing new programs. The council is scheduled to meet bimonthly during after-school hours.

The council met five times during the 1986-87 school year. At the first of those meetings on October 28, Sue Stetzer reviewed the history and purpose of the collaborative. Wayne Ransom described the council's role as one of helping to identify opportunities for teachers and providing direction for the collaborative. The council discussed existing programs and their relationships to the collaborative. Members in attendance felt the meeting was worthwhile and appreciated the diversity of the group. A few participants expressed a "wait-and-see-what-develops" attitude, while others began to identify people who should also be involved. This first meeting resulted in the name change to PMSC.

Following the first meeting, the Advisory Council membership was expanded to include the school district's director of Computer Science Technology, as well as additional representatives from Temple University, the College of Textiles and Science, and the University of Pennsylvania. This brought the total Council membership to twenty-four.

The second meeting of the Advisory Council was held December 17 at The Franklin Institute. Eighteen people attended. The agenda included a report on collaborative activities and a lengthy discussion of the Professional Enrichment Grants (PEGs).

These grants are available to high school mathematics and science teachers to attend professional conferences and workshops. It was decided to include both professionally active teachers and those who have yet to be introduced to conference participation. Frank Betts of PRISM offered up to $1,200 to match the collaborative's funds for grants to teachers in nontargeted schools. The meeting was productive and participants appreciated that everyone was allowed to participate in the discussion. Because the meeting went so well, everyone was very encouraged about the future of the collaborative.

During the meetings in February, April, and June, 1987, the Advisory Council sought to define its role more clearly and to identify ways in which each member might contribute resources to the collaborative. Problems associated with identifying and securing resources from colleges and universities, and from the business and corporate communities became a dominant theme. At the February meeting, coordinator Sue Stetzer distributed and discussed a list of proposed goals for the future. At the April meeting, Mark Driscoll of the UMC Technical Assistance Project spoke to the council about the resources available to the Philadelphia collaborative through the Technical Assistance Project. Dr. Driscoll also discussed ways in which the UMC collaboratives nationwide are growing and helping teachers to network and access resources. The issue of achieving increased participation among teachers was addressed as well.

A move is currently underway to redefine the membership and structure of the collaborative's Advisory Council. Two issues have prompted this change. One problem involves a collaborative policy that a representative from each of the target schools should serve on the council. The projected increase in participating schools would make membership unwieldy and unbalanced within the present structure. A second concern is that strategies are being sought to increase the Advisory Board's participation in policy formation for the collaborative. One committee structure that would address both problems would include a twelve-member steering committee, which would be aided by a program planning committee and a communications committee. These subcommittees would each meet bimonthly, on alternate months, to provide direction and to address issues of linkages with other initiatives both within and outside PRISM. The program committee would identify those activities that were appropriate, as well as resources available to the collaborative and its members. The communications committee would concern itself with the transfer of information and ideas within and between school buildings, and to the community at large.

The Philadelphia Math Science Collaborative has focused on six secondary schools. The decision to limit the project to six high schools was based on a desire to establish an identity in the face of the many other activities already available to teachers in the Philadelphia area. A collaborative involving all schools would be viewed as identical to many other such projects; a collaborative that initially involves only six schools does not experience

pressure to develop large-scale activities, but can work on a small scale to develop strategies to get teachers involved in programs already available. Restricting the initial efforts of the collaborative to six schools thus facilitates project management and makes it easier to identify schools that are committed to the collaborative concept.

On June 16, 1986, the collaborative invited principals and science and mathematics department heads from the six target schools to a recruitment meeting. The schools, chosen by David Williams, Director of the Division of Mathematics for the School District of Philadelphia, represented typical inner-city schools. These particular schools were selected because their mathematics department heads had already participated in some PRISM-sponsored programs. Also in attendance were Dr. Williams; Dr. Francis Betts III, the executive director of PRISM; Don Steinberg, the director of the Division of Science for the School District of Philadelphia; Wayne Ransom, the director of education programs for The Franklin Institute and of the Philadelphia Math Science Collaborative project; and Sue Stetzer, who was to become coordinator of the Philadelphia Math Science Collaborative.

At the meeting, Ms. Stetzer outlined the goals of the collaborative and the services the Philadelphia Math Science Collaborative expected to offer to participating schools. These services included: professional consultations and secretarial help in the preparation of PRISM minigrants; facilitation of exploration of curricular areas of common concern in joint mathematics-science department meetings; help in identifying and obtaining speakers from the business, industry, and academic communities; and support for teachers in areas in which they identify specific professional needs. In exchange for these services, each participating school was asked to agree: to hold a minimum number of joint math-science department meetings during the 1986-87 school year; to provide access for the collaborative coordinator to attend department meetings and to meet with mathematics and/or science teachers individually or in groups; and to support the goals of the collaborative.

The general response at the meeting was favorable. The mathematics department heads knew Sue Stetzer well and were generally receptive. The science department heads, on the other hand, tended to be somewhat skeptical. At the meeting, a letter of agreement was distributed, and the principals and department heads were asked to return a signed copy by June 26 indicating their willingness to participate. All letters of agreement were returned.

The six target schools for the Philadelphia Math Science Collaborative and each school's student enrollment are: Murrell Dobbins Vocational-Technical (1,993); Martin Luther King (2,041); Overbrook (2,283); Roxborough (1,333); Thomas Edison (1,667); and West Philadelphia (1,640). All are inner-city schools. The student population at four of the schools is nearly all black. At

Roxborough, 50 percent of the students are black, and 48 percent of the students are white. At Edison, 37 percent of the students are black, 59 percent of the students are Hispanic, and 3 percent of the students are white. Of the students who graduate from these six schools, 30 to 40 percent plan to go on to some form of higher education, 5 to 10 percent plan to go into the military, and 5 to 40 percent plan to work. On average, about one-third of the teachers at each high school are black and two-thirds are white. Two of the high schools have Hispanic teachers. The number of mathematics teachers at each school ranges from ten to fifteen; the number of science teachers ranges from six to fifteen.

Four of six target schools operate on an abbreviated daily schedule. Consequently, there is no lunch period, and school is dismissed at 1:18 p.m. This type of schedule increases teachers' isolation both by making brown-bag lunch seminars impossible and by reducing the probability of these teachers participating in after-school programs (which usually start at 4 p.m.).

Procedures for selecting three more schools were discussed at an April meeting of the Advisory Council. There had been a belief initially that magnet schools should be excluded, as they served an elite class of students and were relatively well serviced. The district directors of mathematics, Dr. Williams, and science, Mr. Steinberg, argued against this view on the grounds that these schools tend to have a more senior staff who had been away from training for many years, and who needed the stimulation that involvement could provide. Further, in excess of 60 percent of students in these schools were from minority groups. In response to these concerns of the district directors, magnet schools were considered for inclusion.

The twelve department heads from the original six target schools attended a luncheon meeting in May, 1987. This meeting also focused on the appropriateness of a range of criteria for selection of new target schools.

In identifying the next schools to join the collaborative, the attitude of the principals, the level of commitment by mathematics and science teachers, and, implicitly, the capacity of the departments to create access that facilitates interaction between department heads and teachers and the project coordinator, were taken into account.

The project coordinator views as important a perception among teachers that the collaborative complements and supports the efforts of the district's mathematics and science directors. The importance of the directors' influence on collaborative processes should be seen in this light, as should the planning of activities such as the workshops offered by the project.

D. Relationship with Other Local Initiatives

Several key organizations in Philadelphia sponsor activities that have a direct bearing on the support of mathematics and science teachers in the city and, therefore, impact directly on the activities of the collaborative. They include The Franklin Institute (the funding agency), CSPPS, PRISM, PRIME, and ATMOPAV.

The Franklin Institute has a 150-year history of promoting science and technology. As the region's only science and technology center, the Institute has valuable expertise to apply to the improvement of science and mathematics education. It has been a pioneer in the area of experimental education, including hands-on exhibits, resource materials and kits, and it has conducted seminal work in evaluating the effectiveness of exhibits and other informal teaching media. The Franklin Institute has a strong tradition of cooperative relationships with other organizations in the private and public sectors and has been deeply involved in new initiatives in mathematics and science teacher training.

The Committee to Support Philadelphia Public Schools (CSPPS) was started more than three years ago as an organization comprised of high-level corporate, higher education, and foundation executives. The CSPPS has approximately $2.5 million available to support teaching programs; the committee established a humanities task force, and initiated PRISM.

PRISM is an alliance of educational and cultural institutions, governmental agencies, corporations, the Philadelphia Federation of Teachers, and the School District of Philadelphia. PRISM's purposes involve stimulating interest in science and mathematics education, assisting teachers in increasing the effectiveness of their instruction in science and mathematics, and supporting the efforts of the school district to increase enrollment in these areas. PRISM's activities are primarily developmental in character, intended to increase resources available for instruction in mathematics and science through the creation of programs that have the potential to become financially independent. A limited professional staff consults on program design and financing and monitors quality control in PRISM-supported programs. PRISM neither solicits funding from the public nor provides total funding for any single program. Programs supported by PRISM, in addition to the collaborative, include the Teachers Advisory Group, PRISM Institute, the PRISM minigrants (jointly administered by PATHS), PRIME, the Math/Science Clearinghouse, PTIP (Philadelphia Teacher in Industry Program), and PRISM Colloquia.

PRISM was relatively new when the Philadelphia Math Science Collaborative was formed. Since then, PRISM has been reorganized in order to coordinate a broad range of activities. The organization became more structured in February, 1986, with the appointment of Dr. Francis M. Betts as executive director. With

the announcement that Dr. Betts will be leaving in July, 1987, to assume a superintendent's position in Colorado, the future structure of PRISM is not as certain as it might otherwise have been. Any PRISM restructuring may affect the financial and managerial arrangements of the collaborative.

In April, 1986, PRISM formed a Teachers Advisory Group (TAG). Teachers are appointed to the group through nomination by the school district, the Philadelphia Federation of Teachers, and area professional associations of teachers in science and mathematics. The group serves as an advisory body to PRISM in planning new programs, evaluating ongoing programs, and communicating with practitioners in the field. Each TAG member will work closely with one PRISM project in both an advisory and leadership capacity, thereby joining with representatives of the school district, cultural and educational institutions and corporations on program advisory boards.

PRIME was established in 1972 at the initiative of General Electric; it is a program of PRISM. PRIME has actively supported improvements in school mathematics and has expanded its interest from engineering to other areas, such as pharmacology and actuarial work. PRIME consists of thirty-two businesses, seven colleges, nine environmental organizations and two school districts, Philadelphia and Camden. Two thousand children participate in its programs, with 450 enrolled in summer programs. PRIME focused on two initial goals. The first was to garner commitments from the district regarding staff development for higher levels of mathematics. The second was to combine informal programs through The Franklin Institute and other agencies with formal programs and professional societies to improve what was considered to be poor communications between the colleges and schools. It was believed that PRIME could act as a catalyst because of its independence from other groups and organizations.

The Association of Teachers of Mathematics of Philadelphia and Vicinity (ATMOPAV) has an active membership of approximately 850 high school and college mathematics teachers. It provides regular programs and a newsletter.

Six institutions of higher education in the Philadelphia area have offered cost-free course auditing during the 1986-87 school year to Philadelphia public school teachers involved in PRISM programs. The courses are offered to enable teachers to strengthen their professional growth in science, mathematics and the humanities. The sponsoring institutions are the University of Pennsylvania, Community College of Philadelphia, Villanova University, Bryn Mawr College, Beaver College and Chestnut Hill College.

E. Project Activities

During the 1986-87 school year, the Philadelphia Math Science Collaborative sponsored a variety of activities and programs designed to promote teacher leadership and team building among teachers in the six target schools. They are described in the section "Collaborative Sponsored Activities."

Another goal of the collaborative is to increase teacher participation in the many professional-development programs offered in the Philadelphia area; during the 1986-87 school year, a wide array of such programs and activities were available to secondary mathematics teachers. The majority of these events were planned by CSPPS, PRISM, The Franklin Institute, the Division of Mathematics of the School District of Philadelphia, and ATMOPAV. The collaborative supported these related activities by publicizing the events, encouraging teachers to attend, and, in a few cases, providing some funds to contribute to the event or to allow teachers to attend. These activities are described in the "Collaborative Supported Activities" section.

Early in the 1986-87 school year, Coordinator Sue Stetzer met with each of the mathematics and science departments at the target schools during their regularly scheduled meetings. She outlined the goals of the collaborative and discussed the services it could offer. Each school expressed different needs so that the in-school component of the collaborative's activities took shape in six different ways, resulting in a wide range of activities within the target schools. These activities are described in the section "Target School Activities."

COLLABORATIVE SPONSORED ACTIVITIES

"Meet the Directors" Meeting

On December 3, 1986, a wine-and-cheese reception was held to enable mathematics and science teachers in the district to meet the school district's director of mathematics and director of science. Forty teachers, including six from the target schools, attended the event at The Franklin Institute. The meeting was viewed as a success; teachers enjoyed getting together with one another as much as meeting the directors. Dr. David Williams, the Director of Mathematics Education, was so pleased that he suggested such a gathering be held monthly.

Target School Luncheon

On March 14, 1987, the collaborative sponsored a luncheon for mathematics teachers from the target schools and representatives of the district's mathematics departments in conjunction with the Mathematics Leadership Conference at Host Farms in Lancaster. The luncheon provided an opportunity for teachers and administrators to meet, socialize, and discuss common concerns. One teacher commented, "It was delightful, useful. It was a nice setting at a professional level. We voiced some concerns about PRISM grants or irritations with funding." Another said, "It gave me a chance to speak to people at different schools. I met some former classmates and we exchanged ideas." A third lamented, "It is pathetic the cages we are in in our own little rooms. It is so rare to talk to another adult in a nice setting. Teachers are so burdened that it is like we are on an assembly line and there is no time to talk."

The on-site observer noted that "a wonderful feeling came out of this luncheon. Teachers felt they were part of something special."

Luncheon Meeting

On May 6, 1987 the Philadelphia Math/Science Collaborative sponsored a luncheon to discuss and evaluate the collaborative with science and math department heads, directors, and teachers from the six target schools.

One teacher commented, "This was nice, really nice for everyone to get together and talk about common concerns--also to hear other perceptions. There were some differences of opinion. It is good to be able to collaborate. The bottom line is putting material in teachers' hands." Another stated, "It was very nice. It is nice to be given the opportunity to tell about the strengths and weaknesses. It was good to talk to each other because we don't often have that opportunity. It was nice to learn what is happening in other schools." The on-site observer noted: "I think the discussions were positive--they were certainly active (and noisy). The most important aspect that came out clearly was that math and science departments need to talk to each other, to find out each others' needs."

As part of PRISM's documentation project, surveys were distributed to the department heads and teachers who attended, asking them to report on the changes they had observed as a result of the collaborative, what they valued most about the collaborative, the problems they identified that should be addressed by the collaborative, and their suggestions for the coming year. The answers indicated that there has been a rise in involvement in professional organizations, workshops, conferences, and other professional activities, increased awareness of grant

opportunities and increased access to materials. The teachers valued highly the opportunity to share ideas with other teachers, the monthly newsletter, the professional opportunities, and in general, "the fact that someone out there cares." Teachers identified such needs as increased communication between mathematics and science departments and help in increasing meaningful computer use among teachers and students. Problems of student motivation also were mentioned. Suggestions for next steps included in-school networking; in-service training on computers, leadership, and motivation; and a focus on the problems that "students face daily."

Mathematics Department Heads' Annual Luncheon

On May 21, 1987, the mathematics department heads' end-of-year luncheon meeting was held at Roxborough High School, paid for by the collaborative. Twenty-eight department heads, and the Director and Assistant Director of Mathematics Education heard two teachers report on the PRISM grants they had received.

One teacher commented, "I enjoyed it; it enhanced our professionalism and showed us an example of special education students learning a useful trade while at the same time providing a social opportunity for teachers to exchange ideas and good wishes." Another said, "I loved it. I enjoyed the opportunity for collegial interactions relative to specific uses of the computer, because it gave me the opportunity to know that other people were having the same problems that I was having."

The Assistant Director of Mathematics Education said, "It was lovely--one of the most beneficial meetings. It opened discussions of things we have not explored. It is a beginning of new directions for us and renewed commitment to get this task moving."

Geometric Supposer Workshop

On April 24, 1987, the collaborative sponsored a workshop on the Geometric Supposer at the Regional Computing Resource Center, Philadelphia College of Textiles and Science. A representative from the Sunburst Communications Company presented the session. Thirty-one high school teachers, supervisors of math, and key math personnel attended.

One teacher commented, "It was good, very nice. We could explore on our own and see how our students could explore. I learned that relationships are important while computation is less important. It would have taken at least a class period to do what we did in less than 1/2 hour. We are all held back in geometry because of computation." A second teacher said, "Having people with similar interests working together, sharing ideas and

socializing is valuable." Another said, "I enjoyed the opportunity to work with my colleagues on an intelligent, intellectual level."

As a result of this introduction to the Supposer, teachers from four schools expressed interest in joining a network of Geometric Supposer users across the country. This network will be coordinated with EDC, and will allow teachers to use the telecommunications equipment already in their schools to share feedback on their use of the Supposer. The on-site observer noted, "there was a great deal of interest in the software and the added possibility of networking created a lot of interest."

Dues to Professional Organizations

In the 1985-86 school year, the Philadelphia Mathematics Collaborative paid the ATMOPAV membership fee for every Philadelphia public high school mathematics teacher, increasing the organization's membership by about 250. During the 1986-87 school year, the collaborative paid the ATMOPAV membership fee for all the mathematics teachers in the six target high schools. The collaborative also pays the membership fee to the Philadelphia Secondary Science Teachers Association for the science teachers in those six schools. In 1987-88, the collaborative intends to pay half of the fee for those teachers in the 1986-87 target schools, and all of the fees for those in the three new target schools.

Philadelphia Math Science Collaborative Newsletter

Sue Stetzer, coordinator of the Philadelphia Math Science Collaborative, edits a monthly newsletter that is sent to the mathematics and science teachers in the six target schools. Copies of the newsletter also are sent to the principals, and to mathematics and science department heads in all high schools in the district. Sue Stetzer delivers copies of the newsletter to the target schools, taking the opportunity to visit with teachers.

The first issue of the newsletter, published in November, 1986, described the collaborative and PRISM. The newsletter explained that the collaborative was trying to determine what can be done to make the teacher's job easier. Programs designed to reduce teachers' isolation and to increase collaboration with their peers in the business, industrial, and academic communities were listed. The newsletter also included a calendar of relevant events in November and a questionnaire seeking feedback about what teachers would like to see the collaborative doing. Responses to the questionnaire included "desire for involvement with industries," "reduce work load by not having to write school plans," and "open communications between mathematics and science teachers."

The newsletter was published eight times between November, 1986, and June, 1987. It reported in December on the collaborative's change of name from the Philadelphia Mathematics Collaborative to the Philadelphia Math Science Collaborative. The newsletter also provides a calendar of events that may be of interest to mathematics and science teachers, reports on upcoming activities (whether organized by the collaborative or not), and provides a forum for the exchange of items of concern to its readers.

Mathematics in Applications Networks

In fall, 1986, the collaborative initiated plans to establish a teachers' network in Mathematics in Applications, a new third-year nonacademic mathematics course. This network will attempt to distribute public-domain software and teacher-written templates to be used with Appleworks and the Graphics Department. Teachers will act as the primary source of materials for the network. An article in the December issue of the collaborative newsletter requested teachers to submit to Sue Stetzer ideas, software they have developed, or activity plans they have prepared. In early 1987, eighty-five copies of software and an accompanying twenty-page booklet describing teacher activities were distributed to mathematics department heads and to all teachers of the course Mathematics in Applications. In addition to the materials, ACCESS, a newsletter that lists resources and sample activities, was circulated. Three issues were distributed.

Clearinghouse

Related to the establishment of the Mathematics in Applications Network, the PMSC also provides a clearinghouse service to teachers in its target schools by keeping these teachers notified of resources for classroom use. In the December issue of the PMSC newsletter, teachers were informed of two video cassettes they can get free of charge from a project sponsored by Phillips Petroleum Company. The two video cassettes include seven programs about mathematics and problem solving. Another resource available was the loan of energy-related computer software, compatible with the Apple IIe, from the Philadelphia Electric Company.

COLLABORATIVE SUPPORTED ACTIVITIES

1986 Summer Institutes

During the summer of 1986, PRISM sponsored three Summer Institutes for Philadelphia mathematics teachers. Each Institute

combined theory (often taught by a college faculty member) and classroom applications (taught by a Philadelphia school district administrator). The participants received a modest stipend and an allowance to cover the cost of books, materials, and tuition. Each participant earned six graduate credit hours. Although the PMSC was not in a position to support the Institutes actively, the events were the successors to the 1985 Summer Institutes, which were supported by the original collaborative. In fact, one of the Institutes was consciously designed as a follow-up for teachers involved in the previous summer's activities.

Eighteen teachers participated in the first of the three Institutes, which was held at Chestnut Hill College. The two graduate-level courses taught were "Topics in Calculus" and "Methods and Technology in Teaching Calculus."

The second Institute was held at Drexel University. Seventeen teachers took the three courses offered: "Introduction to Analysis," "Special Topics in Mathematics," and "Special Topics in Computer Sciences." (This Institute was very similar to the 1985 Institute that had been cosponsored by the collaborative.)

PRISM's final 1986 Summer Institute, also held at Drexel, was an intensive two-week workshop on computer applications. Fifty-nine teachers from the nine high schools that had been awarded the Ben Franklin grants participated in the program. The School District of Philadelphia loaned each participant a computer for home use during the summer. PRISM equipped the computers with telephone modems to enable the teachers to connect to PRISM's electronic bulletin board, "High Tech Talk." The workshop proved to be the first telecommunications experience for many of the teachers. Teachers from four of the six target schools participated.

All three Institutes appeared to be very successful. Dr. David Williams, Director of Mathematics Education, observed: "This is a stimulating, rigorous experience for teachers; they work very hard, enjoy it, while improving themselves professionally." The Director of PRISM, Dr. Francis Betts, said, "PRISM Summer Institutes enable teachers to learn both up-to-date information in math and computers and also how to apply this to the classroom. And the camaraderie and creativity generated by the Institutes translates directly into renewed enthusiasm when the teachers return to their classrooms in the fall."

PRISM Curriculum Forums

The collaborative publicized in its newsletter, through ACCESS, and in the coordinator's school visits four Curriculum Forums PRISM offered on March 5, March 25, April 1, and April 23 at the University of Pennsylvania Faculty Club and Temple University Faculty Club. The Forums were designed to give teachers an

opportunity to voice their concerns about curriculum. The teachers were promised that David Williams, Director of Mathematics Education, would address their concerns and possibly make changes reflecting their input. Each meeting was held after school, and twenty-five to thirty K-12 mathematics teachers attended. At each session, teachers met in groups of eight to ten to discuss particular curriculum issues. A group leader summarized the results of the discussion and the recommendations of the group at a PRISM-sponsored dinner following each session. Leaders also sent reports to the district's Division of Mathematics Education. Each leader received a $50 stipend for their efforts.

The Curriculum Forum Series was enthusiastically received, perhaps due in part to the willingness of the school district's Mathematics Division to listen to the teachers' suggestions. Some group reports were used immediately in the district's review of the curricula for grades 7 and 8. Teachers' comments reflect their appreciation. One teacher said, "I am glad I participated in this. People needed more direction and were interested in learning techniques. The collegial sharing was wonderful. Most people in my group enjoyed participating and want to continue. We shall meet again to continue our discussion." Another stated, "Interested teachers could discuss curriculum with no time constraints and the people downtown will answer our complaints." Many teachers' groups established at the Forum have continued to meet on their own to discuss curriculum issues.

Science and Math Teachers' Workshop

On February 26, 1987, a workshop for science and math teachers, sponsored by the Philadelphia Electric Company (PECO), was held at the Sheraton Hotel, Valley Forge. The program included dinner and a panel on "Guiding Students to Careers of the Future." The collaborative promoted the workshop through its newsletter and during school visits. One teacher commented, "I found it interesting to get information concerning the current state of engineering education and jobs. It could have been better publicized and attended by math people." Another stated, "The speakers were personable and related to the audience. The program was well planned. I would like to have included strategies for attracting minority students in the inner city high schools."

Programs for Teaching

On February 28, 1987, a Philadelphia Federation of Teachers annual conference entitled "Programs for Teaching" was held at the Wadham Franklin Plaza Hotel and Friends Select School. Thirty-two members of the Philadelphia Federation of Teachers attended a workshop presented by the collaborative's coordinator Sue Stetzer, Judy Berman, and Leslie Cavanagh. The program, entitled "Solving

the Problems of Teaching," was one of many from which participants were able to choose. It focused on the implementation of PRISM grants in recipients' schools.

All teachers interviewed said the activity was worthwhile. Comments included: "I liked it a lot. It gave the people what they came for. It gave ideas regarding grants. It was helpful and at the same time, we were able to pick up good teaching strategies." Another appreciated "being able to be in contact with the recipients of mini-grants and discuss grants, materials available and applications," but didn't like the fact that "they focused on the content rather than the process and development of a grant."

Salute to Teachers

A reception celebrating National Science and Technology Week and Mathematics Education Month was held at The Franklin Institute on April 6, 1987. Financial support for the event came from ATMOPAV, PRISM, PSST, and The Franklin Institute, as well as from the collaborative. Sue Stetzer was instrumental in obtaining the funding from ATMOPAV, as well as in the distribution of invitations. Approximately 200 Philadelphia K-12 math and science teachers attended.

One teacher commented, "It was well attended. It was well done. I thought the math displays were good. I played with the puzzles. I got good ideas from the presentations. However, more was available for elementary schools. I'd like to see more for senior high--more math for my computer class." Another teacher stated, "I really thought it was nice. There was a good combination of high school and elementary school presentations. Unfortunately, math was sent upstairs." The on-site observer felt that "the math presentations were an afterthought. It seemed to be geared toward science teachers."

Demonstration of Corvus Computer

A demonstration of Corvus-driven compute_ networking was held on April 27 at Martin Luther King High School. The meeting was organized by the department head, who was interested in setting up a computer network within the school. Eighteen department heads and other administrators at the high school, as well as collaborative coordinator Sue Stetzer, attended the meeting. This activity demonstrates the leadership and initiative that department heads in the six target schools have begun to assume.

Lego Logo Demonstration

On June 25, 1987, a demonstration of Lego Logo products was held in conjunction with a Seymour Papert press party at The Franklin Institute. The collaborative supplied a guest list for the event; thirty teachers and school officials were invited to attend. Seymour Papert spoke to the gathering.

One teacher commented, "The best part of something like this is the collegiality--talking with people on your own professional level. I think tonight is important because Logo empowers people. That is what these toys do--empower people. This is what we should be looking for. It gives the teachers and kids the ability to approach problems and come up with something to do with them. What I try to do myself is to come up with mental toys." Another said, "First of all the concept of Lego Logo is very exciting educationally. Fabulous! The fact that in research they found out that girls are not intimidated. They jump right in and got involved. When they got closer to adolescence, they shied away from it. That gives me a hope. This gathering is wonderful. It is so easy to exchange ideas and reestablish old contacts. We need this--especially after a tough year. It really is a recharger."

Appleworks Staff Development Workshop

During the 1985-86 school year, the School District of Philadelphia and Sun Oil sponsored a five-week training program in the use of the Appleworks software package. On-site training by Sun Company personnel was offered after school one day each week to twenty to thirty teachers from each of five senior high schools during the months of April and May. In fall, 1986, a five-week training program in the use of the Appleworks Software package was offered several times. In addition to personnel from the Sun Company, employees of Smith Kline & Beckman, Cigna, and Mellon Bank participated. During 1986, such training was offered to teachers in twenty-eight senior high schools, including the collaborative's target schools.

High Tech Talk (HTT)

High Tech Talk, PRISM's electronic mail bulletin board and teleconferencing system, was tested in early 1986 and came on-line 24 hours a day in May. The system operates out of the PRISM office in the United Engineers Building. HTT is viewed as a means of linking educators with their industrial counterparts through a rapid, convenient, and inexpensive means of communication. The system is available to all Philadelphia mathematics and science teachers. PRISM will aggregate teachers' individual orders for modems and communication software in order that teachers can

benefit from a bulk discount purchase price. In the summer of 1986, PRISM acquired fifty modems for distribution to teachers participating in the PRISM Summer Institute on Computer Applications in Teaching. In the fall, the modems and software were redistributed to math and science departments for use in instructional support.

High Tech Talk provides a variety of services to science and mathematics teachers. The main menu lists the following submenus: Administration; Bulletin Boards; Clearinghouse--PRISM's Information Center; List of HTT Members; Electronic Mail; The Problem Solver's Corner; University and College Information; and Special Interest Groups. Among the information included under "Bulletin Boards" are activities of professional societies, public domain software, and Swap Shop. "Clearinghouse" includes the complete Philadelphia Math/Science Resource Catalog (which lists twenty-one field-trip sites dealing with science and mathematics), plus a calendar of professional programs. The Electronic Mail Section allows users to leave messages for one another, including pages of text. The Problem Solver's Corner encourages professional level communication on scientific, technical and pedagogic issues. The Philadelphia Math Science Collaborative hopes to encourage ongoing communication between the target schools through High Tech Talk and has, therefore, established its own bulletin board on the system. It is anticipated that the teachers will use it to share ideas and objectives.

Currently, more than 100 teachers are using HTT, including some from the collaborative's target schools. Those teachers who participated in the Summer Institute appear to be the most active users.

ATMOPAV Meetings

The collaborative pays ATMOPAV's annual membership fees for teachers in the target schools, and publicizes its activities in the newsletter.

Fall Meeting. The ATMOPAV Fall Meeting was held Saturday, October 25, 1986, at the Philadelphia College of Textiles and Science; the meeting's theme was "Mathematics: Today and Tomorrow." As part of the day-long meeting, the collaborative cosponsored a luncheon and issued invitations to teachers from the target schools.

Teachers from the collaborative who attended appreciated the speakers but were somewhat overwhelmed by the number of concurrent sessions. Ninety people attended the luncheon, including members of the collaborative, speakers, members of the ATMOPAV board, and past presidents of ATMOPAV. This was a good opportunity for the teachers to socialize with one another and to exchange ideas.

Winter Meeting. The ATMOPAV Winter Meeting was held Saturday, January 24, 1987, at Beaver College. The theme was: "Serious Enjoyment through ATMOPAV of Numbers Creatively Encountered." The collaborative cosponsored a luncheon associated with the meeting, and invited target school teachers.

Spring Meeting. The ATMOPAV Spring Banquet was held May 7, 1987, at Williamson's Restaurant in Horsham, PA. Approximately 105 persons, seventy from ATMOPAV and thirty-five from the Bucks County Council of Teachers of Math, heard Joel Schneider of Square One TV speak about the Square One television program. The collaborative paid half of the speaker's fee. One teacher stated, "The thing that amazed me was how many secondary teachers were unaware of Square One. It forced people to view at least one segment and evaluate it. It was a good opportunity to get local organizations together. It was better to have just a banquet than a workshop and dinner." Another said, "I thought it went well. More people were involved and attended than we had in the last few years. It was nice sharing the work. I enjoyed the speaker. I was so excited to go just to hear him."

The on-site observer noted, "This was the first time Bucks County and Philadelphia shared a program; it worked out well."

Available Newsletters

A variety of newsletters were distributed during the 1986-87 school year to the secondary school mathematics teachers of the School District of Philadelphia. Among these were: "Continuum," a newsletter published jointly by PATHS and PRISM six times each year, includes information about the Philadelphia Math Science Collaborative; "Communique," published by the CSPPS; "PSST Newsletter" published by the Philadelphia Secondary Science Teachers; the "ATMOPAV Newsletter;" and the newsletter published by the School District of Philadelphia. The ATMOPAV Newsletter, which is published three times each year, also promotes activities for and provides information about the Philadelphia Math Science Collaborative. Sue Stetzer, the coordinator of the collaborative project, is also the editor of the ATMOPAV Newsletter. In addition, the collaborative publishes its own newsletter.

Minigrants: Conferences and Conventions

The collaborative provides Professional Enrichment Grants (PEGs) to high school mathematics and science teachers in the Philadelphia public schools to enable them to attend professional meetings, workshops, and seminars. Through the PEG program, nine teachers from target schools and twelve from nontarget schools attended mathematics and science conferences across the country.

The collaborative had $4,800 to offer to teachers from the target schools, plus an additional $1,200 earmarked for teachers in nontarget schools. In addition, PRISM has offered to match the $1,200 stipend to nontarget schools, and the Technical Assistance Project of the Urban Mathematics Collaborative provided $600 to allow some teachers to attend the National Educational Computing Conference; this money was used in lieu of sending a teacher to the TAP-sponsored Exeter activity.

Grants are to focus on a general area of professional development. The collaborative budgeted $400 for each department within each school; individual grants were not to exceed $250. Interested teachers submitted an application form to Sue Stetzer at least thirty days prior to the event or meeting for which funding was requested. Teachers from the six target schools were given priority.

Mathematics Leadership Conference. The second annual Mathematics Leadership Conference, sponsored by the School District of Philadelphia, was held March 13-15, 1987, at Host Farms in Lancaster. Approximately 253 math teachers from the school district of Philadelphia and a number of parochial teachers who came as guests attended. The collaborative provided funds through the PEG program for eight teachers to attend this meeting.

The conference was well received. One teacher commented, "It allows teachers to communicate about school related matters in a nonthreatening manner. Fosters new friendships." Another said, "There was a good selection of presenters who were actually teachers instead of the professor types. It is better to hear from teachers who do the same as we do all the time." The Director of Math Education stated, "It was a wonderful experience. I was impressed with the warmth, camaraderie and caring that was seen here this weekend."

It should be noted that the Mathematics Leadership Conference, with eight target school teachers attending, accounted for the entire mathematics grant money of four of the six target schools.

Philadelphia Council of Teachers of Mathematics (PCTM) Annual Meeting. Twelve collaborative teachers, including two teachers from the Philadelphia school district who had received PEG grants, attended the PCTM annual meeting on March 20, 1987, in Harrisburg, Pennsylvania. Sue Stetzer and Diane Briars of the Pittsburgh collaborative gave a joint presentation about their respective collaborative. The teachers enjoyed the conference and the networking that occurred. One teacher commented, "I enjoyed attending the meetings. It gave me a chance to see what was working in other schools. It was a good meeting." A second said, "It was a wonderful opportunity to get away from the pressures of school and to network. Too bad more teachers did not have the same opportunity."

NCTM Annual Meeting. Five collaborative teachers received financial support to attend the NCTM Annual Meeting held April 8-10, 1987, in Anaheim, California. Comments from those five teachers emphasized the meaningfulness and excitement of this conference. One teacher said, "I think it charged me up--renewed vigor and interest. We were able to bring back information and share it with other teachers. Teachers from all over the country had profound respect for teachers from Philadelphia. When they saw our badge, they automatically gave us a salute." Another stated, "It gave me a chance to network, to see what was working with other teachers. It was a good learning experience--a real shot in the arm for me. I experienced the professionalism of teaching. You don't always feel professionalism when teaching in Philadelphia. It takes an NCTM meeting to realize that. I felt that I was looking for ways to make me a better teacher. There wasn't enough at a high school level to use with a general math class. I went to junior high school things. We are often the forgotten teachers." A third teacher added, "We met members of the collaboratives from all over the country. We had common concerns."

NECC Conference. The collaborative and the Technical Assistance Project funded nine teachers, including two from target schools, to attend the National Educational Computing Conference (NECC), held June 24-26, 1987 at the Convention Center in Philadelphia. The conference was well attended and appreciated. One teacher commented, "The school district should make this kind of meeting available to more people. I have really enjoyed it and got a lot out of it." Another said, "I've never been to this kind of conference. It's nice--really nice. I've been to book fairs. These exhibits are much more interesting."

Mini-grants: Classroom Projects

The Philadelphia Math Science Collaborative also supported mini-grants from other sources by providing in-service and consultation to teachers preparing proposals. During the 1986-87 school year, PRISM awarded fifty-five mini-grants to teachers or to groups of teachers to support innovative and experimental projects designed to enrich classroom experiences in mathematics and/or science. Fifteen grants went to mathematics teachers, three of whom taught in high schools. Grants of $300 were made to individual teachers, while groups of teachers who collaborated on a project received up to $3,000. A mini-grant fair was held November 12 at which projects funded by mini-grants were featured.

During the 1986-87 school year, the collaborative made a concerted effort to assist teachers in the six target schools in applying for mini-grants. The coordinator met with teachers to help them identify and develop program ideas, and the collaborative provided technical support (including typing) for the grant requests. In order to encourage further applications, a session on

writing mini-grant applications, led by PRISM documenter Elizabeth Haslam, was held for mathematics department heads in December, 1986.

TARGET SCHOOL ACTIVITIES

Department Meetings

Each mathematics and science department is directed by the school district to hold a monthly meeting; these generally occur on the second or fourth Tuesday of each month. In line with its goal that mathematics and science teachers interact on a more regular basis, the collaborative required that a minimum number of department meetings are held jointly.

The collaborative's impact on these department meetings has been clear in a variety of ways. For example, the collaborative has been instrumental in arranging for some of the joint department meetings to be held at The Franklin Institute, including the October 24 meeting of twenty-five teachers from Dobbins Area Vocational Technical School. Participants commented that it was the first time that the mathematics and science teachers had an opportunity for formal interaction. This, and the information they received about The Franklin Institute, made the meeting very worthwhile.

The mathematics and science departments of Edison High School held a joint meeting on December 9 at The Franklin Institute. Eighteen teachers from Edison toured the Institute's newly reopened mathematics exhibit. Teacher reactions to the meeting were very positive.

As a result of collaborative encouragement, departments have met to review computer software; the science department at West Philadelphia High School met November 25, the science department at Martin Luther King High School met December 1-3, and the science department at Dobbins High School met December 5. On March 24, the collaborative organized a program on software by Scott Steketee, a professional writer of software and a teacher in one of the new target schools for 1987-88, for twenty-four members of the joint math/science department of Martin Luther King High School. The department heads found the activity to be very worthwhile.

When possible, collaborative coordinator Sue Stetzer attends department meetings. At these meetings, she has worked with teachers on a needs assessment, which included documenting the "base line" that represented the current level of activities of teachers in both "in-school" and "out-of-school" activities. She has also provided assistance to teachers in developing objectives for the school year.

Ms. Stetzer's department visits have had a very positive effect. One department chairperson who had previously not been involved in the collaborative contacted her for a recommendation of a speaker for a departmental meeting. He told Ms. Stetzer that he used to invite speakers to departmental meetings but had gotten lazy, and that "you really inspired me so I am getting it together." As early as November, this department head had scheduled programs for his department meetings all the way through March.

Workshops and Speakers

Target schools held a variety of workshops and presentations with the collaborative, many of which were funded through PRISM grants which the collaborative helped initiate. Speakers were very often invited to joint mathematics-science departmental meetings.

Each of the six target schools took advantage of Professional Enrichment Grants offered by the collaborative to send teachers to professional meetings, conferences, and workshops. In many cases, application for these grants was the direct result of regular contact between the schools' mathematics and science departments, and Sue Stetzer.

At West Philadelphia High School, college and university professors and school district personnel have spoken to eight department meetings on problem solving and other current issues in mathematics. Teachers have felt a new sense of professional involvement and have been able to devote time to the consideration of pedagogical issues within the constraints set by the district. These presentations were funded by a mini-grant from PRISM; Sue Stetzer, the current collaborative coordinator, applied for this grant while she was department head at West Philadelphia High School.

Edison High School sent five teachers to conferences, including NECC, the NCTM national meeting in Anaheim, and an Environmental Protection Agency seminar on pollution. Department head (Sue Stetzer) had applied for the money as a result of her involvement with the collaborative.

In general, the workshops were enthusiastically received. One teacher commented, "Each time we have had a meeting, they get better and better. I was getting tired of problems but they developed some strategies and it is all coming together." Some teachers have felt, however, that the workshops did not apply to the students they taught. One teacher said, "The problems given were great for us, but nothing that students would be able to solve. A lot of students don't even want to be in class, let alone solve problems." Another said, "Our problems are not with problem solving, it is with the academic level of our students. No one is addressing what we can do about raising the academic level. We are

grappling with the fact that 66 percent of our kids are below the 16th percentile in math."

Roxborough High School had previously received a PRISM grant which funded staff training for utilizing computers to teach Mathematics in Application, a nonacademic third year mathematics course. Many of their activities were geared toward implementing the grant. For example, at a joint meeting of the mathematics and science departments on December 2, Dr. Miriam Yevick of Rutgers University discussed her book Mathematics for the Billions. Twenty-four teachers attended this presentation; while they felt that some concrete applications of mathematics were offered, their general response was that the talk was not as valuable as it could have been. This grant, obtained through the efforts of the department head, fostered collegiality among teachers.

On February 17, 1987, Sue Stetzer taught a spreadsheet workshop at Roxborough High School. The workshop was designed to instruct mathematics teachers on the use of spreadsheets in the Mathematics in Application course. Eight members of the mathematics department attended. The teachers felt the activity was worthwhile, and several suggested more time or training. They seemed to be excited that they could use Appleworks. One teacher commented, "Everyone was actively involved with the computers. Sue was well prepared." Another said, "Sue knew the material well. She has a dynamic delivery because she took time with us." Other comments included, "Sue presented the material slowly. It gave us a chance to digest it. I wish we could do it in the a.m. when we are wide awake. I was able to use a spreadsheet a week later and I knew how to do it." "I wish we had more time to do these things during schooltime."

A Roxborough High School teacher was awarded a PRISM grant for the 1987-88 school year to use the Geometric Supposer in her classroom. The department used Professional Enrichment Grants to send five mathematics teachers to professional meetings.

Involvement in the PMSC appears to have restimulated the mathematics department at Edison High School. Outside speakers were invited to address monthly departmental meetings. Representatives of the school district and Drexel University spoke to joint meetings of the math and science departments on topics ranging from Mathematics in Application to stoichiometry. Edison High School sent five teachers to conferences, including NECC, the NCTM national meeting in Anaheim, and an Environmental Protection Agency seminar on pollution. In addition, nearly the entire mathematics department attended the Mathematics Leadership Conference, and a degree of camaraderie was developed there.

The Overbrook High School mathematics department was unfamiliar with the use of computers to teach mathematics and invited Sue Stetzer to present workshops at department meetings. On March 26, 1987, Ms. Stetzer explained spreadsheets and ACCESS to fifteen members of the math department. Ms. Stetzer reported that

the meeting went very well, and that the teachers were excited with the activity. The teachers discovered that they were able to perform well despite their fears of the new technology. The department won a PRISM telecommunications grant and funded four teachers' attendance at professional meetings.

For the past three years, the staff and students of Martin Luther King High School have been relocated in another building while asbestos was removed from the school. Students and staff will return for the 1987-88 school year. To date, the impact of the collaborative and the responsiveness to Sue Stetzer's efforts have been limited. The major result of collaborative involvement was the school's successful application for a modem grant. In addition, a teacher organized a presentation of Texas Instruments hardware, and a joint math-science presentation on software was presented by Scott Steketee. The school has also sent one science and one mathematics teacher to national conferences.

Teachers at Dobbins High School received three grants from PRISM: one which supplied modems in both the mathematics and science department offices, one which funded the mathematics department to purchase and use software in the classroom, and one for the purchase of an Apple IIGS system for the science department. Dobbins also sent three teachers to the Mathematics Leadership Conference.

F. Observations

The Philadelphia Math Science Collaborative has made great strides since it was reorganized in the latter half of 1986. Discussion of the collaborative's growth will focus on four major issues: Project Management, Collaboration, Teacher Professionalism, and Mathematics Focus.

PROJECT MANAGEMENT

The hierarchical structure of the PRISM organization is something of a double-edged sword in relation to the involvement of groups other than the teachers. On the one hand, it protects the collaborative from the need to expend too much energy in raising funds. At the same time, however, it tends to set an additional distance between nonteacher participants and the actual activities of the collaborative.

The scope of PRISM's documentation component currently includes the Philadelphia Collaborative. This initiative is staffed by Dr. Elizabeth Haslam, who has visited each participating school and interviewed a teacher and several students at each site on three occasions. Dr. Haslam has developed a good sense of the dynamics of the schools concerned, and has provided valuable input

and a fresh perspective to Sue Stetzer as coordinator at their regular meetings. A report was produced at the end of the school year.

With the departure of the PRISM director to Colorado, the organization's future is unclear. This situation has a set of implications for the governance and funding of the collaborative.

The real organization of the PMSC at an operational level consists of Sue Stetzer, Wayne Ransom, Joyce Neff, and, to a lesser extent, Elizabeth Haslam; these four individuals meet formally each month for planning, review and implementation. There is concern about the low level of involvement of the Advisory Council as both a planning and a policy group. As a result of the lack of communication between board members there has been little coordination at times, among the activities of various organizations. For example, the collaborative's coordinator was not advised of teacher workshops organized by Drexel University. In part the problem is one that has arisen from the previously described PRISM structure, but it is probably more a historical than a determining condition.

A conscious effort has been made to increase the Advisory Council's involvement in policy formation, with Dr. Ransom and Ms. Stetzer establishing responsibilities for board members. This restructuring of the board will provide an opportunity for more meaningful involvement and participation of its members.

Sue Stetzer has brought both the needed vision and the energy to the Philadelphia Math Science Collaborative. During the 1986-87 school year, she was on leave from her position as a department chair and was paid by the Philadelphia school district. The Franklin Institute partially reimbursed the school district, providing the funds to pay the salary of the teacher who taught in Ms. Stetzer's place. This arrangement, however, could only be made for one year. Ms. Stetzer has agreed to continue in the position as coordinator. This required negotiations with the union and action by the school board; in addition, Ms. Stetzer lost her rights to the position of department head at her former school. She does, however, retain the right to take up a corresponding position there or in another school. Ms. Stetzer's commitment to continuing as the coordinator on a more permanent basis is seen as a significant development, as her leadership has been very important to the vitality of the collaborative.

The credibility of the collaborative has been established among the teachers as a consequence of the initial goodwill and status that Ms. Stetzer brought to her role as coordinator, and as a result of her spending a lot of time in the participating schools. In fact, the collaborative is often defined by teachers as "what Sue Stetzer does." This is probably inevitable to a great extent in that the project operates in a resource-rich environment, with organizations such as PRISM, PTIP and PRIME all engaging in educational support activities that impact on the work of

significant numbers of mathematics teachers. It is useful for teachers to identify a particular project with a single person. It is also an outcome of Ms. Stetzer's very active strategy and the time she has spent in the target schools, identifying the project as a networking and clearinghouse service for teachers. In this way, the collaborative has been able to establish an identity for itself: a task that has posed problems in the past. It will always be difficult to differentiate clearly the project from the rest of PRISM, and it may be a futile task to try to so do beyond a certain point.

Ms. Stetzer's linkages with the district and local mathematics education organization have been critical in the recasting and establishment of the collaborative as one with a future in Philadelphia. The collaborative is now an active and identifiable entity within the complex of support offerings for teachers in the district. As the on-site observer noted, "The collaborative has become a real part of the Philadelphia math/science educational scene." The project has established a niche for itself in promoting school-based programs. This focus fits well with the effort of the coordinator to be physically present in the schools, and to engage the teachers in each target school in organized activities.

As part of Ms. Stetzer's plan to establish an identity for the collaborative, she has made a concerted effort to be sure that others in the community are aware of its existence and programs. She spoke at a committee on collaboratives chaired by Dr. Kelner of the school district. At that meeting, Ms. Stetzer distributed the "Apple for a Teacher" flier and talked about how teachers should be aware of the collaborative. Representatives from Penn State, Penn, Temple and PRISM, as well as various school district personnel, were in attendance.

In her position as project coordinator, Ms. Stetzer is able to enhance the professional life of mathematics teachers beyond the activities of the collaborative. She was, for example, asked to suggest teachers who would receive invitations to hear Seymour Pappert speak, even though his presentation was not sponsored by the collaborative.

COLLABORATION

The collaborative's emphasis on six target schools has introduced a new element of collaboration into support activities in Philadelphia. In the past the collaborative had focused its efforts on encouraging teachers to participate in the wide variety of activities offered to mathematics teachers by PRISM, the Committee to Support Philadelphia Public Schools and other organizations. With the establishment of the Math Science Collaborative, the project has initiated activities directed at forming cohesion between the mathematics and science departments

within the target schools. For example, one of the prerequisites for becoming a target school is that the math and science departments hold a number of joint departmental meetings. This has certainly helped to foster communication and perhaps an initial level of collaboration among the teachers in the two departments at each school.

The collaborative newsletter has been very successful in contributing to communication and collaboration, and appears to be well read. Dr. Alex Tobin, director of PRIME, commented that as a result of a short newsletter article about an NSF math project, he received numerous requests from teachers and from one school board member for more information.

The collaborative has begun to encourage cooperation within the Philadelphia educational community. For example, as a result of contacts established through the Philadelphia Math Science Collaborative, ATMOPAV and Temple University have worked closely together in organizing the association's annual meeting on that campus. This is the second time since the collaborative was established that a university has offered ATMOPAV its facilities. In 1985, Drexel made a similar gesture.

Building business-school alliances is currently being explored in order to create networks between mathematics teachers in the target schools and others associated with the use of mathematics. To date, the local energy company and two other local corporations have been approached. If successful, this activity will further broaden the scope of collaboration in Philadelphia.

Ms. Stetzer's determination to further involve the collaborative board is important for a number of reasons. First, if networking is to occur between interest groups, then it must be effective at the board level. Second, if the tradition of outside provision of service to teacher clients is to be successfully challenged, then the changed relationships necessary will have to manifest themselves at the policy-making and decision-making levels. Third, if teachers are to be best supported in their efforts to change the quality of their work, then effective and frequent communication is essential.

PROFESSIONALISM

The collaborative's strategy has focused on interdepartmental collaboration and helping teachers decide which activities they feel would be most productive. For example, the collaborative has supported teachers' efforts to seek mini-grants; while the grants came from outside resources, the initiative for teachers to submit a proposal came from their association with the collaborative. Teachers are beginning to feel that they can take the initiative to improve their professional lives.

As teachers within a school work together to take greater advantage of outside resources and activities, it is possible that the nature of the collaborative's offerings will change. What goes on within the schools will impact upon what activities will be offered in the future and what dynamics will be used to encourage teachers to participate in those activities.

Ms. Stetzer's capacity to alert department heads to available resources has occasionally resulted in a tendency on the part of some departments to rely on being "fed." The collaborative has resisted this response and, as a result, failure to assume the responsibility to stay informed has, in a few instances, caused a department to miss the opportunity to obtain equipment grants or conference support.

The relationship between the teachers in the target schools and the bureaucratic demands of the school district, such as the mandated curricula, will warrant careful observation during the next few years. As teachers in these schools gain power and collaboratively develop improved programs within schools, they will challenge current curriculum policies. The ways in which such challenges are negotiated within the Philadelphia schools should be of interest to the Ford Foundation and others interested in curricular and institutional change.

The release of significant numbers of teachers to attend the Geometric Supposer workshop was a new step for the district, and one that could represent a significant development in the district's attitude about freeing teachers to attend enrichment activities. The cooperation of two district offices in setting up the activity and releasing of teachers was essential, particularly as the workshop was developed outside the district organization.

MATHEMATICS FOCUS

The collaborative, which has been active in providing teachers with a broader sense of mathematics, has emphasized department meeting presentations that stress problem solving and mathematics applications. An effort also has been made to provide teachers with software so that computers can be used more effectively in mathematics instruction. In addition, the collaborative has encouraged and helped to facilitate teachers' attendance at professional meetings. Teachers' attendance at professional mathematics education meetings will keep them current on mathematics education issues. It is too early to predict how these experiences will impact on classroom teaching. It will be interesting to see how the new ideas to which teachers are exposed are integrated into the mandated curriculum. What is evident is that the Philadelphia Math Science Collaborative has made great strides toward infusing teachers with a more enlightened view of mathematics.

G. Next Steps

In order to broaden the collaborative's leadership base, and to increase the proactive role of the Advisory Council, a major focus of the project for the next twelve months is the restructuring of its Council. Members have been asked to volunteer to serve on one of three committees (steering, program planning, and communication). These will assume increased visibility as part of the attempt to generalize perceptions of the collaborative beyond the role of the coordinator.

Three additional target schools have been recruited for the 1987-88 school year. Two of the three schools are typical inner-city schools. The third, the High School of Engineering and Science, is a desegregated magnet school for math and science in the heart of North Philadelphia. The three schools all bring a common interest to the collaborative. They are interested in participating in a proposed Geometric Supposer Network; all three participated in the Supposer workshop and were enthusiastic about the software. They all have access to computer labs for teaching geometry using the software and all have modems to provide a telecommunications link with their counterparts in other collaboratives across the country.

The immediate concern of the Philadelphia Math Science Collaborative is the establishment of close ties with the nine target schools. With the reorganization of the collaborative, the focus has shifted from serving mathematics teachers to linking mathematics and science departments. The collaborative will continue to arrange joint departmental meetings within each school to foster the exchange of concerns, ideas, and information. The collaborative also will continue to promote dialogue among the mathematics and science teachers in the six target schools. Next year, the number of target schools will be increased to nine.

The collaborative will continue to organize "Meet the Directors" sessions. These meetings give mathematics and science teachers the opportunity to become better acquainted with the district's curriculum directors, as well as with one another.

The collaborative will continue to develop ACCESS, the Math in Application Network that it initiated in fall, 1986. Additional software will be distributed as teachers submit materials. The collaborative is considering establishing a similar network for science software.

In order to encourage teachers to attend professional conferences, the Philadelphia Math Science Collaborative will provide funds for some teachers to attend meetings, such as those of the Pennsylvania Council of Teachers of Mathematics, NCTM and NSTA. The collaborative will again pay for teachers to attend mathematics and science conferences.

PRISM sponsors an ongoing curriculum forum on a variety of topics for grades K-12. The coordinator of the collaborative will help organize and support this forum; PRISM, however, will provide all of the funds.

During summer, 1987, local colleges will offer short courses or Institutes. A short course on calculus will be held at Chestnut Hill, a course on discrete mathematics will be held at Beaver College, and a Woodrow Wilson Institute on statistics, cosponsored by the collaborative, will be held at the community college.

SUMMARY REPORT:
PITTSBURGH MATHEMATICS COLLABORATIVE

by

Urban Mathematics Collaborative Documentation Project
University of Wisconsin-Madison

PURPOSE OF THIS REPORT

This report summarizes the activities of the Pittsburgh Mathematics Collaborative during the 1986-87 school year. The report is intended to be both factual and interpretive. The interpretations have been made in light of the long-term goal of the Ford Foundation to increase the professional status of mathematics teachers in urban school districts and the way in which the activities of the collaborative during the past year have evolved in order to reach that goal.

The information presented in this report came from the following sources: the proposal submitted by the Pittsburgh Mathematics Collaborative to the Ford Foundation for the continued funding of the collaborative; documents provided by the project staff; monthly reports from the on-site observer; the meeting in San Francisco in October, 1986, of representatives of all of the projects; the directors' meeting held in St. Louis in January, 1987; meetings held during the annual NCTM conference in April, 1987, in Anaheim, California; survey data provided by teachers; and three site visits by the staff of the Documentation Project.

PITTSBURGH MATHEMATICS COLLABORATIVE

A. Purpose

The six goals articulated in the initial proposal for the Pittsburgh Mathematics Collaborative continue to provide focus for the collaborative. The project's goals are:

1. to overcome teachers' isolation and to increase opportunities for interaction;
2. to educate the community about the professional nature of high school mathematics teachers;
3. to enhance teachers' knowledge base of mathematics applications;
4. to provide opportunities for professional self-enhancement;
5. to provide opportunities for teacher recognition; and
6. to provide time for teacher interaction, work, and professional development.

The long-range goal of the collaborative, as stated in the 1986 proposal for continued funding, is the institutionalization of a set of structures and processes that will continuously foster teacher professionalism and will be decreasingly reliant on external administration and facilitation. Attainment of this goal is partially dependent upon the identification of resources to cover ongoing program costs. In light of this goal, collaborative activities are guided by a vision that by 1990, Pittsburgh will have:

1. an energized secondary mathematics faculty, deeply involved in mathematics curricular and policy issues, and continuously interacting with the larger community;
2. a community that is knowledgeable about secondary mathematics issues and appreciative of secondary teachers;
3. a series of mechanisms in place to promote exchange and interaction among teachers and community leaders in business, industry, and higher education; and
4. a public more aware of the importance of mathematics in students' educational development and in adults' professional lives.

B. Context

The Pittsburgh metropolitan area has a population of 2.5 million. The city itself has a population in excess of 400,000. The area is served by the Pittsburgh Public Schools District. Dr. Richard Wallace, Jr., the superintendent since the 1980-81 academic year, has announced that he will retire in 1990. The central office support for curriculum areas was reorganized at the start of the 1985-86 academic year. As a result of the reorganization, Dr. Diane Briars was appointed in February, 1986, to the then newly created position of associate director for mathematics.

A school closure program is nearing completion, with eighteen schools closed over the past seven years. The district serves approximately 40,000 kindergarten through twelfth-grade students. Of the student population, approximately 50 percent are black and 50 percent are white, with other minorities, including Asians, represented in only small numbers. The organization of the schools has been standardized so that all twelve high schools are comprised of grades 9-12, all sixteen middle schools are comprised of grades 6-8, and all forty-eight elementary schools are comprised of grades K-5. Good relations exist between the superintendent's office and the local teachers' union.

The district has 126 high school mathematics teachers. Of these, ten are black. All 126 teachers are fully certified to teach mathematics and average twenty years experience in the classroom. The district has done little recruiting for some years, as its population has declined; this year, for example, only two new teachers were hired. Teaching positions will soon open as teachers in this maturing teaching force retire.

The district has actively addressed its declining enrollments and its desegregation plan. Two high schools have been merged into one for the 1986-87 school year, reducing the number of high schools in the district to twelve. Magnet schools provide a means of voluntary desegregation. The value of some magnet programs became evident in November, 1986, when parents waited in lines in below-freezing temperatures for four days to register students in magnet middle and high school programs.

In the fall of 1985, teachers received a three-year contract. In January, 1986, Superintendent Wallace secured a four-year contract. Together, these contracts will help to ensure stability in school district working conditions through 1988.

The teachers' union is strong. Consequently, considerable detail is written into the contract. For example, all teachers get two or three Mondays or Fridays leave so that they can have an occasional three-day weekend. (On one of those days, Friday, February 27, the collaborative sponsored a trip to a nuclear plant.) The top salary for the current school year is $39,000; it will be $40,000 next year.

A high school day consists of seven periods, with a twenty-minute homeroom period at 7:40 a.m. The day runs until 2:20 p.m. Teachers teach five classes, and have one free period and one duty period (study hall, hall guard, etc.). Principals are considered school leaders; they appoint the department heads and set the schedule. The principal can ask for help from the department head, who is paid an additional $1,200 per year and gets one extra free period per day. Teachers serve on committees, such as those focusing on textbook selection and curriculum development. Assignment to these committees is desirable because they meet for two weeks during the summer and teachers receive extra pay. Summer school teachers are selected based on seniority. The summer school program lasts six weeks and, until recently, focused primarily on remediation. The schools operate on a full year, rather than a semester, schedule. Some consideration is being given to returning to a semester schedule so that students who are failing at midterm can repeat the course, rather than failing a complete year.

As of this year, students need three years of mathematics to graduate. However, this can be achieved in many ways. For example, students can take two years of general math and a senior review, or one year of general math and two years of Algebra 1. The district is now working on a revised General Mathematics 1, 2, 3 sequence. Students are also required to pass a competency test to graduate; if they fail the test in tenth grade, they must pass the Business Mathematics class in order to graduate.

Teachers have been required to attend two full-day inservices that are structured by the district's associate director for mathematics and two half-day inservices directed by the principals. This year, the collaborative planned the two half-day inservices previously led by the principals. Teachers can take increment credit courses in order to move up the pay scale. One such course, "History of Ideas in Math," was taught by the district's associate director, Dr. Diane Briars, from 4 to 6 p.m. on eight to ten consecutive Mondays. The secondary mathematics supervisor, Howard Bower, has organized another course, "Calculus Review," which is being taught by a retired mathematics teacher.

Schenley High School and Teaching Center, which was built more than 50 years ago, has recently been renovated. About 1,000 students attend the school. Two-thirds of the students are black; many of the remaining one-third are Asian. Two magnet schools are housed at Schenley--the International School and the High Technology Magnet School. Most students in the International School have been together since elementary school. The student population at the High Technology magnet is comprised of an equal number of minority students and white students. For every black student who is accepted, one white student is accepted. If a student of one group applies and there is no application by a student of the other group, enrollment is frozen until such time that two students--one black and one white--can be admitted. Students in the magnet schools mix with students who attend Schenley's regular program.

The Teacher Center, which has been operated by school district staff for four years at Schenley High School, may be abolished next year. Nearly all of the secondary school teachers in Pittsburgh have spent an eight-week session at the center learning about PRISM (Pittsburgh Research-based Instructional Supervisory Model) and teaching.

The PRISM program, designed to improve instructional and evaluation techniques, is based on an adaptation of Madeline Hunter's Effective Teaching Model. The model describes the four major elements of effective instruction:

1. Select an objective at the correct level of difficulty.

2. Teach to an objective.

3. Monitor the progress of the learner and make adjustments in the teaching.

4. Use, without abuse, certain principles of learning.

Since 1981, when the PRISM program was initiated in the district, first principals, and then department chairs, were trained to perform teacher observations. Over the past six years, all of the secondary mathematics teachers have been trained at Schenley. In their absence, classes were taught by trained "replacement teachers."

At the Teacher Center, each teacher is assigned to a Clinical Resource Teacher (CRT). CRTs have the same seven-period day as other teachers, but they teach only three to four high school classes. Instead, they have one preparation period, one period with each of the teachers assigned to them, one period teaching a class of teachers, and one duty period. The assigned teachers attend classes, work with their assigned CRT, and do special projects. During the training, four areas are stressed--critical thinking, higher order questioning, testing, and progressive discipline. In addition to covering Madeline Hunter's model, the teachers may attend lectures on educational psychology, development theory, and mathematics topics such as problem solving using calculators and computers. Every second week during each eight-week session, teachers participate in an internship chosen by them and their CRTs. An internship may involve working in industry or completing a special project at home. After teachers leave the center, specially trained teachers observe them in their classrooms.

The impact of this training is noticeable. Teachers inculcate the Hunter model into their own classroom activities. In one case, an observer noted that a geometry teacher followed the recommended procedure of writing the day's objective on the board; used guided practice by checking understanding by requiring a student to answer a question; and provided instructional input by reviewing the applicable r les.

Since 1981, the school district also has implemented the Monitoring Achievement in Pittsburgh (MAP) program, an instructional testing system designed to increase student achievement in basic skills. Superintendent Wallace formed the MAP committee to allow teachers to formulate objectives for each grade level and tests to evaluate their achievement. Diane Briars is currently arranging for the MAP mathematics committee to review the objectives in order to eliminate those that are no longer considered relevant, and to include emphasis on such areas as problem solving.

Components of MAP include the identification of skill expectations, focused instruction, the monitoring of achievement, appropriate instructional resources, attending to time on task, and staff development. The MAP Mathematics Program covers objectives for grades 1-8, General Math, Algebra I and II, Geometry I, and Consumer Math. All students mainstreamed in these grades and courses take multiple-choice tests on twenty to thirty-one objectives at each level; one test item is used for each objective. The tests are computer scored, and the results are reported on the Class Diagnostic Summary and the Student Achievement Report.

The district's next initiative will involve establishing Centers of Excellence at each high school. In each school, a shared governance committee of administrators and teachers will identify an educational project. At Schenley High School, for example, the committee meets after school to discuss ways to get better test results from their calculus students. At another school, the staff has chosen to focus on the difficult time the students have had making the transition from eighth grade to ninth grade.

C. Development of the Collaborative

For most of the 1986-87 school year, the Pittsburgh Mathematics Collaborative was administrated by Coordinator Dr. Leslie Salmon-Cox and Assistant Coordinator Dr. Martina Jacobs. Dr. Salmon-Cox is affiliated with the Learning Research and Development Center at the University of Pittsburgh. In March, Dr. Jacobs resigned from the project to become director of Kaufman's Triangle Program, an initiative to support area women in careers. On April 15, Ms. Barbara Bridge became assistant coordinator of the Pittsburgh Mathematics Collaborative. Ms. Bridge, who holds a master's degree in communications, has a strong background in marketing and sales. She has worked at the Pittsburgh Press, and more recently, at the Pittsburgh Post-Gazette, where she developed curricula for the use of newspapers in classrooms, acted as liaison between the newspaper and local educators, made in-school presentations, and conducted tours of the newspaper facilities for students and teachers. Ms. Bridge will work jointly with the collaborative project and with Jeanne Berdik in the Partnerships in Education Program (PIE).

Dr. Diane Briars, the school district's associate director for mathematics, provides a major link between the collaborative and the district. The on-site observer is Ms. Rosemarie Kavanagh, a retired mathematics teacher.

Collaborative governance is shared among the Steering Committee and its Executive Committee, both of which were actively involved in writing the initial proposal, and a group comprised of the department chairs from each of the high schools. The Steering Committee meets once or twice annually to discuss the direction and activities of the collaborative. The department chairs met monthly throughout the school year to work on specific activities, such as planning inservice workshops. The department chairs act as the major communication channel between the collaborative's administration and the teachers. In 1985-86, there were thirteen department chairs; the merging of two high schools in 1986-87 reduced group membership to twelve. Both the secondary supervisor and Diane Briars work closely with the department chairs. As a result of its activities during the first year of the collaborative and of the interaction between the collaborative coordinator and the school district administration, the department chair group has increased in status within the district and is now referred to as the Mathematics Curriculum and Policy Advisory Committee.

Steering Committee

A twenty-nine member Steering Committee was established in spring, 1985. The committee is comprised of three representatives from the school district administration; four teachers; three representatives from universities; one from a community college; five from institutes and foundations; five from community councils; five from corporations; one from the Buhl Science Center; one from the Federation of Teachers; and the collaborative director. At their initial meeting, members of the Steering Committee stressed the importance of coordinating the needs of industry with the education of future employees.

The Steering Committee met on December 11, 1986, to review the collaborative's accomplishments and current goals. Concerns included students' failure to understand the need for mathematics and the consequent low enrollment in mathematics classes, and disinterest in the collaborative by some district teachers. In response, the committee suggested that the collaborative should air mathematics programs on WQED, the educational television channel, and encourage teachers to attend a dinner meeting. The committee also discussed involving all high school mathematics teachers in the collaborative and the potential future scarcity of mathematics teachers in Pittsburgh. It was noted that middle school teachers would like to be involved in the collaborative; collaborative representatives explained the Ford Foundation's funding conditions that limit their participation, and suggested ways that middle school teachers may participate in some activities. Participants

suggested pairing high school and middle school teachers for classroom visits. The committee felt that meeting more often than twice each year was unnecessary unless a particular need arose.

Executive Committee

A small group comprised of Leslie Salmon-Cox (Pittsburgh Mathematics Collaborative), Barbara Bridge (PMC and PIE), Diane Briars (Pittsburgh Public Schools), Nancy Bunt (Allegheny Conference on Community Development), and Jeanne Berdik (PIE) meets monthly to review collaborative activities and plans. This group, which meets the first Tuesday of each month, is referred to as the "First Tuesday Committee." Its regular meetings facilitate the coordination of the collaborative's major resource components, particularly in terms of establishing a link with the school district.

Curriculum and Policy Advisory Committee for Secondary Mathematics

The mathematics department chairs have evolved into a strong group which, in the latter part of this year, became the Curriculum and Policy Advisory Committee for Secondary Mathematics. There is now a growing emphasis on involving teachers other than department chairs.

The mathematics chairpersons from each high school met with Dr. Briars monthly during the 1986-87 school year. Meeting topics ranged from calculators in the classroom to honoring innovative teachers. In July, for example, the chairpersons met with Dr. Salmon-Cox to review the collaborative's progress during the 1985-86 school year and to highlight plans for the fall. Dr. Briars and Dr. Salmon-Cox reported that a placement guide to help counselors place students in mathematics classes had been developed and that calculators had been ordered. The group agreed that each department would decide how best to distribute the calculators within each school, and that district-wide policy would be developed in spring, 1987. The committee met again in September, October, November, and December.

At the first meeting of the second semester, the chairpersons discussed a method for choosing a "teacher of the month" at each school as a means of recognizing innovative teachers and boosting morale. (A different school was to be highlighted each month.) Other agenda topics included resource materials that had been ordered, the February In-service, Mathematics Awareness Month (April), and future meeting dates. One chairperson reported on conference meetings that could qualify for professional development teacher grants, and a listing of these was distributed.

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The collaborative has cooperated with the University of Pittsburgh in writing a proposal to create six tuition-free fellowships for secondary mathematics teachers to enroll in graduate-level courses. The proposal awaits final approval of the new university provost, who will be appointed in fall, 1987. The collaborative and the University of Pittsburgh also have discussed developing joint mentor programs for student mathematics teachers, and the role of the collaborative in a program to recruit bright undergraduates to careers in teaching. Plans are underway to work with other institutions of higher education in the Pittsburgh area.

E. Project Activities

During the 1986-87 school year, Pittsburgh's 126 secondary mathematics teachers were offered the opportunity to participate in a variety of collaborative activities, including a reception, seminars, computer training, curriculum development involving the use of calculators, and tours of local industry (many of which were scheduled on designated teacher inservice days). These activities are described in the section "Collaborative Sponsored Activities."

The collaborative also paid teachers' expenses to enable them to take advantage of professional opportunities offered by other local organizations, including professional meetings and a lecture series. The collaborative also cooperated with other local initiatives to help teachers develop and submit applications for professional enrichment grants. These activities are described in the section "Collaborative Supported Activities."

COLLABORATIVE SPONSORED ACTIVITIES

Collaborative Reception

On Monday, June 16, 1986, a reception for Barbara Nelson of the Ford Foundation was held in the U.S. Steel Building to celebrate the first year of the Pittsburgh Mathematics Collaborative. Fifty-nine people attended, including teachers, representatives from business and industry, and university faculty. Barbara Nelson presented a comprehensive review of the activities of the other collaboratives, and Leslie Salmon-Cox provided a summary of the year's activities of the Pittsburgh Collaborative. The reception also provided collaborative participants an opportunity to socialize. The department chairpersons met with Ms. Nelson prior to the reception to share their thoughts on various mathematics issues and their ideas about the future of the collaborative.

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schools from those in proprietary schools was pointed out. A mathematics teacher at a community college noted that the students in community colleges and in technical schools were more mature and more attentive and motivated. Part of this the teachers attributed to the fact that the students were now paying for their education and had a specific goal/job in mind.

Computer Training

In August, 1986, the Pittsburgh Mathematics Collaborative received a $20,000 challenge grant from the Pennsylvania Ben Franklin Partnership Program to train a select group of secondary mathematics teachers to become computer literate. Ten teachers were trained to use computers to teach mathematics over the course of the 1986-87 school year; these teachers are expected to become peer instructors in their individual schools. Each teacher was loaned a home computer. The program included evaluation of currently available software, including the use of spread sheets for administrative functions. The teachers will spend five days during the summer of 1987 designing specific lessons that integrate computer software. They expect to pilot some of it next year in their classes. A second-year proposal to the Ben Franklin Partnership Program has been approved and will provide funding for a pilot project during the 1987-88 school year to continue and broaden the teacher training process in one large high school.

Calculator Curriculum Planning

During the summer of 1986, the collaborative funded six teachers to work for a full week with Diane Briars to develop district plans for the use of regular and scientific calculators in general mathematics courses. During the 1986-87 school year, teachers were asked to provide feedback on the plans, and a calculator-per-student policy was adopted. Most teachers reported that the calculators are useful.

In-service Programs

Equibank Tour. The collaborative arranged for teachers to tour the Equibank Headquarters on Friday, October 3, 1986, as an inservice day for a cluster of three high schools. The activity allowed teachers to discuss various banking operations and their mathematics applications and implications with the staff and management of Equibank. Twenty-five teachers, seven supervisors, and two collaborative representatives attended. The bank president and a senior vice president responded to teachers' questions. The executives noted that the commercial phase of business needs employees with college degrees in credit analysis and accounting,

while the consumer phase requires employees who possess skills in addition, subtraction, multiplication, division, and figuring percentages. The president agreed to provide teachers with a sample of the test the bank gives to job applicants, as well as sample problems that could be used in the classroom. A reception followed the tour and discussion session.

Westinghouse Nuclear Training Center Tour. On Thursday, October 9, 1986, a half-day inservice enabled the mathematics teachers of five high schools to tour the Westinghouse Nuclear Training Center. Two managers and an engineer reviewed the mathematics skills required for employment in the nuclear power industry. The teachers viewed training materials, including models of nuclear components and a control room simulator. It was difficult to complete the activity in the two-and-a-half hours provided. Tour evaluations were very positive. Teachers' responses to a question about the most valuable lesson they had learned included: "the need for advanced mathematics and science courses in entry level positions"; "the need to continue to teach fractions and the traditional measurement system"; "service opportunities offered to graduating seniors are not to be overlooked"; and "stressing math teaching is important--made me feel more valuable as a math teacher."

Junior Achievement In-service. On October 16, 1986, the collaborative sponsored an inservice program for teachers from Allderdice, CAPA, Peabody, and Westinghouse high schools. Forty-four people attended the program, which was a panel of participants in Junior Achievement programs (KMG Main Hurdman, Blue Cross of Western PA, and Equibank).

Presentation by Blue Cross. On Wednesday, October 24, all secondary mathematics teachers were required to attend a half-day inservice at which representatives from Blue Cross presented a discussion of spread sheets and their applications to work. The event was sponsored by the Pittsburgh Mathematics Collaborative in coordination with the school district. At the beginning of the session, Leslie Salmon-Cox summarized the activities of the collaborative and discussed its future plans. In addition, Jerry Smith presented a summary of a conference on computer applications he had attended at Exeter during the summer of 1986.

Dravo Automation Sciences Facilities Tour. The Pittsburgh Mathematics Collaborative sponsored a tour and seminar at the Dravo Automation Sciences (DAS) facilities on February 12, 1987. DAS is a division of Dravo Corporation, which specializes in factory automation, systems integration, and management information. Thirty-four participants attended the program, which included an overview of Dravo Corporation and the capabilities of the technology used and developed by DAS, as well as a tour of the

facilities and a discussion of the training and educational background of DAS employees. One speaker expressed his concern that even good students are so dependent upon the calculator that an unreasonable answer often is not even questioned. Teachers responded that the current emphasis on estimation should help to correct this situation. The program ended with a general question-and-answer session and light refreshments.

Materials provided to participants included a breakdown of the academic training of DAS employees (with 18 percent holding no degree, 56 percent holding an associates or bachelor's degree, 23 percent holding a master's degree, and 3 percent holding a Ph.D.). Another handout listed DAS employees by major field of study. Handouts indicated that one-quarter of future jobs in the Greater Pittsburgh region will arise in the high-tech field.

Dravo had arranged for press coverage, and the meeting was highlighted on the six o'clock news. Tina Jacobs and one of the mathematics chairpersons were interviewed.

Presentation by Blue Cross. On February 19, 1987, Blue Cross of Western Pennsylvania presented a program on the actuarial profession for mathematics teachers from Brashear, Carrick, Letsche, Schenley, and South high schools. This presentation was arranged by the collaborative. Nearly sixty people participated, including seven district representatives from the Pittsburgh Public Schools. The program featured an overview of Blue Cross of Western Pennsylvania, a discussion of careers in the actuarial sciences, and a review of the mathematics an actuary uses. Demonstrations of the personal computer as a tool in risk management and the use of financial modeling software had to be cancelled due to technical problems.

The actuaries who addressed the group discussed the training needed for their jobs, including statistics, research methodology, logic, computer science, calculus, linear algebra, probability and mathematical analysis. The actuaries noted that even the company's accounting clerks were required to have about two years of algebra, some understanding of statistical terms, and a good background in logic, estimation, fractions, and decimals. The program ended with a question-and-discussion session and a wine-and-cheese reception. Each participant received a packet of information about actuary science.

Because the professions discussed at this program required fairly advanced mathematical training, some teachers felt the information did not apply to their students. One of the younger teachers who teaches "non-academically inclined" students commented that she merely regarded these meetings with industry as opportunities for her to acquaint herself with professions that might be available to her, not to her students. However, one employee of Blue Cross, who had only a high school education, said the most advanced mathematics her job requires involves figuring

percentages on a calculator. Another attendee commented, "While it was desirable for teachers to learn about these professions to steer their academically inclined students in that direction, this level of achievement is unattainable for the target group of students to which this collaborative has addressed itself. . . . It is my opinion it would be more valuable to survey the mathematics being used by employees at the entry level. These contacts with industry are good in opening doors but the capabilities of the target group need to be addressed if the project is to reach its goal."

Rockwell International Tour. On February 26, 1987, Rockwell International offered a program to teachers from Allderdice, CAPA, Peabody, and Westinghouse high schools. This visit was arranged by the collaborative. Prior to the visit, the assistant project coordinator and a teacher had talked with officials from Rockwell about what teachers would be interested in seeing. Forty-four participants attended, including three district representatives from the Pittsburgh Public Schools. The program included an overview of the Measurement and Flow Control Division of Rockwell International, a tour of the valve engineering and research laboratory, a discussion and demonstration of a typical valve research project, and an overview of the use of mathematical modeling in business planning, sales, and marketing. The presentation emphasized computer science, which has become a necessity in drafting, engineering, and mathematical modeling and simulation of all types. The program ended with refreshments and informal discussion.

Participants received a chart of various categories of mathematics (arithmetic, geometry, algebra, analytical geometry, derivatives, complex variables, vectors, etc.) and computer use and the frequency with which each category was used (daily, weekly, monthly, yearly, almost never) by those working on typical research projects in valve engineering.

Participants were impressed by the amount of time and preparation evidently invested in the presentations. One attendee commented, "Rockwell International must have spent hours in preparation of their program . . . Their presentations were excellent. If the company is that anxious to cooperate with educators, maybe some other help could be secured from them."

COLLABORATIVE SUPPORTED ACTIVITIES

Conference on Computers in Secondary School Mathematics at Phillips Exeter Academy

During the summer of 1986, the Technical Assistance Project at the Education Development Center funded a teacher to participate in

a week-long conference at Phillips Exeter Academy in New Hampshire. The collaborative had notified teachers of the opportunity and identified the teacher that would attend. The conference focused on the impact on and application of the computer in the curriculum. Among the topics discussed were discrete mathematics, new developments in mathematics, and issues in mathematics education. Two teachers received funding to attend the Computer Conference at Phillips Exeter Academy in June, 1987.

Educator-in-Residence Lecture Series

During the 1986-87 school year, the Allegheny Conference Education Fund continued to sponsor a lecture series which members of the collaborative attended. On August 21, 1986, Al Shanker, President of the American Federation of Teachers, gave a presentation on the Carnegie Foundation Report, "Teaching, A Nation Prepared." Teachers, principals, administrators, Partnerships in Education Program coordinators, and corporate representatives attended this presentation at the U.S. Steel Building. Mr. Shanker noted that, as a result of teacher layoffs and their low salaries as compared with comparable jobs in industry, only 6 percent of current college students are interested in teaching. He predicted that unless salary scales and working conditions are improved, and class size is decreased, 50 percent of current teachers will leave the profession.

A second program in the Educator-in-Residence Lecture Series, cosponsored by the collaborative, the Pittsburgh Public Schools, and the Allegheny Conference, was held April 28, 1987. Dr. Zalman Usiskin, Professor of Education at the University of Chicago, gave a two-hour presentation entitled, "Reforming School Mathematics for Today's World." The program focused on the increased needs of high school students for mathematical literacy. Dr. Usiskin stressed the importance of mathematical knowledge beyond that generally obtained in the two years of high school algebra, including statistics, probability, exponential growth, and linear programming, and noted that while mandating a third year of mathematics for all students might help provide this knowledge, it is important to provide interesting curricula for non-academic students.

Dr. Usiskin further suggested that mathematics and science need to be integrated, and that mathematics specialists should teach elementary students much as music or art specialists are currently employed in elementary schools. Dr. Usiskin noted that the Soviets are introducing algebraic concepts to their students in the third grade and suggested that if this were done in America, secondary students would be able to accomplish more in algebra classes since they would not be struggling with the elementary ideas. He further emphasized that especially at the elementary level, a large number of mathematics textbook pages present nothing

new, and suggested that students therefore have a hard time adjusting to the pace required for algebra when they meet it.

From 10 a.m. to 3 p.m., Dr. Usiskin met with forty Pittsburgh Public School teachers, including secondary mathematics chairpeople, a committee working on the redesign of the General Mathematics Curriculum, and the Monitoring Achievement in Pittsburgh (MAP) Mathematics redesign group. The teachers found the experience very rewarding.

The Changing World of Academia and Work

On Monday, September 29, 1986, a presentation on economic forecasting was held in cooperation with the Changing World of Academia and Work Project (a program for counselors) at the Station Square. Carol Monaghan, Director of the Economic Development Committee, Allegheny Conference on Community Development, presented an overview of Pittsburgh's shifting economy. A film produced by Duquesne Light Company described changing economic conditions from the 1700s to the present and prompted a discussion, which was followed by dinner. Attendance was voluntary but was encouraged by the collaborative. Fifty-six mathematics teachers and forty-two counselors from the Pittsburgh and county schools participated.

Professional Enrichment Grants

In fall, 1986, the collaborative announced the availability of Professional Enrichment Grants for high school mathematics teachers. The grants, available through the Allegheny Conference Education Fund, provide teachers with an opportunity to attend professional meetings, workshops, and seminars, and to consult with fellow teachers and colleagues in the private sector. Individual grants may total up to $300. Teachers must submit grant requests sixty days before the event or meeting for which funding is being sought. Two grants were given in partial support of teacher travel to the National Council of Teachers of Mathematics annual convention held in Washington, D.C. Two more went to support travel to the Pennsylvania Council of Teachers of Mathematics Convention in Harrisburg. In a letter to Dr. Jacobs, one of the teachers who received a Professional Enrichment Grant wrote: "Thank you so very much for selecting me as a Professional Enrichment Grant recipient. I am thrilled! The $300 award is deeply appreciated. Thank you for helping teachers to feel like real professionals. The Mathematics Collaborative is a marvelous organization and is doing outstanding work in helping to upgrade the quality of mathematics education. I wanted you to know that all your efforts have not gone unnoticed! If I can be of any service to your organization, don't hesitate to ask."

Committee to Redesign General Mathematics

In response to a new state law that requires three years of high school mathematics instead of two, the Pittsburgh School District established a committee of five teachers and a supervisor to determine the content of that third year. Since its inception, the committee's task has been extended to involve redesigning the entire three years of what is now considered General Mathematics. The committee met monthly throughout the school year and engaged in curriculum writing over the summer, supported in part by the collaborative.

Langley High School Workshop

On January 21, 1987, the Pittsburgh Public School District held an inservice at Langley High School. All mathematics teachers from the Pittsburgh Public Schools were required to attend. Each teacher attended a general session as well as two sessions selected from a list of eight. The sessions included: The Graphics Calculator--An Alternative to Computer Demonstrations; Fractals--On the Cutting Edge of Mathematics; Tessellations by Transformation; Aerobics for the Brain--Mental Mathematics (a modern approach to estimation and mental math approved by the NCTM); Challenge of the Unknown: Problem Solving in the Real World (developed by the American Association for the Advancement of Science); Concrete Models for Teaching Integers and Some Basic Algebra Concepts; Math from the Mechanical Universe; and The Discussion Model in the Math Classroom.

F. Observations

During the 1986-87 school year, the Pittsburgh Mathematics Collaborative continued to make great strides. The collaborative's growth in four specific areas will be addressed: Project Management, Collaboration, Teacher Professionalism and Mathematics Focus.

PROJECT MANAGEMENT

There is a close, tripartite working relationship between Dr. Salmon-Cox, the coordinator of the collaborative project; Ms. Barbara Bridge, the new assistant coordinator; and Dr. Briars, the school district's associate director of mathematics. The three are in constant contact and, based on fairly clearly defined areas of responsibility, share much of the decision making. These three, a member of the Allegheny Conference staff, and a representative of

the Partnerships in Education Program constitute the collaborative's Executive Committee.

The Executive Committee continues to be responsible for many collaborative decisions. The committee meets on the first Tuesday of each month to ensure coordination across the represented group. Diane Briars' participation on this committee, as well as the working relationship that has been established between her and Leslie Salmon-Cox, have resulted in a very close connection between the collaborative and the school district. As Dr. Salmon-Cox explained, "This relation was a matter of luck. Someone else could have been appointed the Associate Director for Mathematics and there could have been a completely different direction for the collaborative." Also, the addition of Barbara Bridge has helped to integrate the collaborative's activities with those of the Partnerships in Education Program.

Three elements of the project's administrative organization require comment. First, the direct involvement of Dr. Salmon-Cox in the day-to-day organizational and intellectual aspects of the project is unique among her counterparts in the other collaboratives. Dr. Salmon-Cox is very supportive of the collaborative. Some procedures, such as that which teachers use to apply for Professional Education Grants, are becoming routinized so that they do not require such effort. Dr. Salmon-Cox feels that, in about a year, as the collaborative becomes more established, the position of project coordinator should be phased out. Having someone fulfill the duties currently performed by the assistant coordinator, however, will continue to be a key element of the collaborative's structure. It is apparent that a distinct separation of responsibilities has evolved. As coordinator, Leslie Salmon-Cox deals with the politics of the district, while the assistant coordinator is responsible for all of the collaborative's initiatives that involve business and industry.

Second, the direct involvement of the school district has enabled the collaborative to develop activities that address the district's problems and priorities. This has, from the outset, provided the conditions necessary to foster teachers' and administrators' feelings of ownership in the collaborative's success.

Third, the complementary skills and knowledge of the three central planners has been reflected in the distribution of collaborative tasks and responsibilities.

Of primary concern to the collaborative over the next two years will be the institutionalization of structures and processes that will continue beyond the period that the collaborative is funded by the Ford Foundation. In addressing this concern, great care has been taken to ensure that all planning involves the associate director for mathematics, the department chairs, and the Steering Committee. In this sense, the collaborative acts not as a director, but rather as a facilitator whose role is to organize

activity, to garner resources, and to establish new interactions and networks.

COLLABORATION

The regular meetings of the Executive Committee ensure close contact between the collaborative and the school district, as well as among the collaborative, the Allegheny Conference, and the Partnerships in Education Program.

Efforts have been made to establish political connections between the collaborative and the district by gaining the support of key people and by keeping these people informed. Among these contacts are principals and the president of the Pittsburgh Federation of Teachers. These connections facilitate the collaborative's efforts to provide recognition for teachers and opportunities for interaction. The Pittsburgh Mathematics Collaborative is also well linked to the school district through the Associate Director of Mathematics and other collaborative participants who serve on various district committees.

The collaborative's coordinator has chosen to work through the department chairs, to gain their support, and to increase their status in the district; the strategy has proven effective in that department chairs have formed a group whose members value meeting regularly. In turn, the district has granted this group greater responsibility for the mathematics curriculum--a change in district structure that could remain indefinitely. It is assumed that a strong department-chair group can be used to encourage collaborative participation among all the mathematics teachers. The collaborative has been successful in involving other mathematics teachers in curriculum revision task forces, as well as in conferences such as that held at Exeter.

The collaborative appears to be having some impact as a result of its work with the school district. In the past, inservice time was scheduled by the principals. All teachers at a school attended the same program, a practice considered by teachers to be generally unproductive. The collaborative asked to plan the inservices for mathematics teachers, a strategy which has resulted in other content-area people developing subject-related inservice programs. Teachers seem to feel they now get more out of the inservices. Furthermore, Secondary Mathematics Supervisor Howard Bower has indicated that the work being done to integrate calculators into the district's classrooms and to help teachers become more knowledgeable about computers probably would not have occurred if not for the collaborative.

The assistant coordinator has made a considerable number of contacts with area industries and businesses as a means of providing the collaborative with a strong community link. Representatives from business, industry, and the higher education

community who have participated in site visits and other collaborative activities are reported to be extremely positive about the programs and the opportunities they offer to talk with teachers.

The primary value of industry site visits is considered to be the opportunity for teachers to learn about what happens at the site. In addition, however, Dr. Jacobs invited individual teachers to accompany her on "planning visits" to various industries in order to discuss with the industrialists the schedule for the site visit and to relay ideas about what the teachers would like to learn. These planning visits provided teachers with an opportunity to interact at a higher level with industry staff by offering input into the content of the site visits.

One link that has yet to be strengthened is that between the collaborative and the university community. Three mathematics professors at the University of Pittsburgh have expressed interest in collaborative participation, but Dr. Salmon-Cox is uncertain about how best to take advantage of their offer. The collaborative's orientation does not lend itself to extended involvement by the School of Education at the University of Pittsburgh. Dr. Salmon-Cox thinks there are some possibilities for collaboration with Carnegie Mellon University. Work being done by Lauren Resnick, a nationally recognized cognitive psychologist and educator, at LRDC may be relevant, but since it is still in its formative stage, it is felt that it would not be very appealing to teachers.

Some collaboration has occurred between the collaborative projects in Pittsburgh and Philadelphia. Diane Briars and Sue Stetzer gave a joint presentation at the Pennsylvania Council of Teachers of Mathematics in spring, 1987. Dr. Briars asked Ms. Stetzer for information about other professional conferences that may interest teachers. These examples illustrate that collaboration goes beyond the confines of a single site.

TEACHER PROFESSIONALISM

Pittsburgh teachers regard themselves as professionals, and the district treats them well. Superintendent Wallace provides strong, progressive leadership. Opportunities exist for teachers to engage in professional development within the district. One teacher said her eight weeks at the Schenley Teacher Center were similar to a sabbatical and made her feel important because she was treated like a professional. For some of the time, she was given responsibility to work on her own and was able to spend a week at home preparing problem-solving lessons on her own typewriter.

Teachers' salaries in Pittsburgh range from $13,000 to $39,000. Money is also available for some teachers to work on a variety of curriculum committees for a week or two in the summer.

Department heads are paid $1,200 in addition to their regular salaries and are assigned an extra free period each day to take care of department business. Teachers remain employed in a region in which many people have lost their jobs.

The teachers' union is strong and some teachers abide by the time requirements it has established; others come to school early or leave late. At Schenley, for example, the committee of teachers and administrators that is developing the school's "excellence in schools" project for the 1987-88 school year frequently meets after school, sometimes until 6 p.m. At Allderdice, one geometry teacher stayed after school to work with students who needed to make up a test or other work.

During the 1985-86 school year, teacher participation in collaborative activities was voluntary. Because teachers were reluctant to leave their classrooms, all collaborative activities were scheduled after school, on free days, or on weekends. Beginning with the 1986-87 school year, however, six mandatory inservice days, two for each of three clusters of schools, were allocated for collaborative activities. As a result, collaborative participation was notably higher during the 1986-87 school year.

The department chairs have exhibited an enhanced sense of professionalism, evident in their increased confidence and in their willingness to address substantive issues. Equally important is the district's recognition of this professionalism, evidenced by the increased level of responsibility it has assigned to the group. This group cohesion and district recognition are the results of collaborative efforts; in particular, the collaborative coordinator made initial efforts to meet with individual department chairs, and, in some cases, with entire departments to initiate activities and to lay the groundwork upon which the department chairs can build.

MATHEMATICS FOCUS

The mathematical focus of the collaborative springs from local initiatives; Dr. Diane Briars, the school district's associate director for mathematics, provides leadership in this area. She has worked hard during the year to broaden the mathematics teachers' professional perspectives. Dr. Briars also is working on a plan to train elementary school mathematics specialists during the summer so they can begin to teach math in elementary schools; the use of elementary school teachers as mathematics specialists has precedent in the use of "generalist" certified K-8 teachers as mathematics teachers in the junior highs. Such a program would have a positive impact on mathematics teaching in the elementary schools; because Dr. Briars thinks it would take too long to provide inservice to all of the teachers, the notion of using specialists has particular appeal. Scheduling, however, is viewed as a major impediment.

The collaborative's mathematics focus is directed toward innovation and progress. As a result of the collaborative, calculators have been purchased for the district's classrooms. Resource books have also been distributed to each department, including a copy of a Transition Mathematics text. Supporting teachers' attendance at professional meetings also helps to keep teachers current regarding new trends.

Six teachers were involved in a pilot test of Algebra I textbooks. For the first time, three texts were reviewed. As part of the text assessment, student achievement and attitudes are being considered.

Another aspect of the collaborative's focus involves real-world applications of mathematics. The assistant coordinator has arranged site visits for teachers at local industries and businesses, and has worked hard to ensure that the industry representatives explain how they use mathematics in the workplace. The presentations' relevancy to teachers, however, has varied from site to site. At Blue Cross, teachers were disappointed with the discussion of actuarial science as they did not feel that the program addressed the needs of graduating high school students. At Rockwell, the industrialists stressed the importance of algebra and the use of computers. Teachers did leave the presentation believing that what they teach is actually being used, although there was not much interaction between the teachers and the Rockwell staff.

In the future, the collaborative will strive to involve local universities and colleges, using their rich mathematical resources to add to the experiences of teachers.

G. Next Steps

It is impossible to predict all of next year's activities, but two projects currently in the planning stages will be important in the collaborative's efforts to institutionalize programs that will continue after the Ford Foundation's collaborative funding is exhausted.

Using already established relationships between the business and education communities, Barbara Bridge will work on intensified partnerships focused on mathematics in two high schools. The two high schools involved are part of well-established partnerships that are likely to continue for several years. In each case, Ms. Bridge and a teacher from the participating school will work with a business representative to design initiatives of particular use and interest to mathematics teachers.

As the result of a Steering Committee suggestion, the collaborative is planning a dinner series for mathematics teachers. The department chairs have strongly endorsed this idea, marking a

decided change from the reaction to a similar proposal a year ago when the group felt there would be little interest among most secondary mathematics teachers. A committee of teachers is planning the series, which, it is hoped, will serve as a vehicle for convening not only secondary teachers but others in the community interested in mathematics issues. The collaborative will help identify and attract speakers and aid in the initial organization. It is anticipated that participants will pay the costs of the dinner, thereby institutionalizing a mechanism that does not require Ford Foundation support.

SUMMARY REPORT:
ST. LOUIS URBAN MATHEMATICS COLLABORATIVE

by

Urban Mathematics Collaborative Documentation Project
University of Wisconsin-Madison

PURPOSE OF THIS REPORT

This report summarizes the activities of the St. Louis Urban Mathematics Collaborative during the 1986-87 school year. The report is intended to be both factual and interpretive. The interpretations have been made in light of the long-term intent of the Ford Foundation to increase the professional status of mathematics teachers in urban school districts and the way in which the activities of the collaborative during its first year have evolved in order to reach that goal.

The information presented in this report came from the following sources: the proposal for funding submitted to the Ford Foundation by the Mathematics and Science Education Center, a Division of the Network for Educational Development; the meeting in San Francisco in October, 1986, of representatives of all of the projects; the directors' meeting held in St. Louis in January, 1987; documents provided by the project staff at the Mathematics and Science Education Center; meetings held during the annual NCTM Conference in April, 1987, in Anaheim, California; and four site visits by the staff of the Documentation Project.

ST. LOUIS URBAN MATHEMATICS COLLABORATIVE

A. Purpose

As stated in the funding proposal to the Ford Foundation, a document written with the active involvement of a group of secondary mathematics teachers, the goal of the St. Louis Urban Mathematics Collaborative is to foster a spirit of collaboration among St. Louis Public Schools mathematics teachers, university mathematics professors, and mathematicians from local business and industry. Teachers expect that the collaborative will:

1. open and expand lines of communication among teachers, and between teachers and various segments of the community;

2. increase teachers' knowledge of mathematics and mathematics applications;

3. garner informed input from local business and industry of the latest technological advances that employ mathematics;

4. demonstrate to students the relevance of mathematics to the work world;

5. improve teachers' instructional techniques;

6. strengthen teachers' bonds with university faculty and other related professionals, and with scientific organizations; and

7. deepen teachers' own sense of professionalism about their careers.

The collaborative's primary goals as stated in the funding proposal are:

1. Teachers will explore potential resources among businesses, industries, and universities to discover how these resources may assist them in their own professional growth and in their classroom instruction.

2. Teachers will develop, assist in developing, and implement staff training programs for themselves and for their peers.

3. Teachers will assist in improving communications and exchanges of information among all mathematics teachers within each school and across schools.

4. Teachers will promote the recognition of accomplishments and quality performance among all mathematics teachers and students.

B. Context

The population of St. Louis is approximately 431,400; the population of its entire metropolitan area exceeds 1 million. Superintendent of Schools Jerome B. Jones directs the St. Louis School District, with the help of one deputy superintendent, two associate superintendents and four assistant superintendents. Deputy Superintendent Cozy W. Marks, Jr. oversees district administrators, including all principals, while Associate Superintendent William A. Pearson oversees the district's curriculum and programs. Curriculum Director Benjamin Price and Partnership Program Director J. Wayne Walker report to William Pearson. The Assistant Superintendent in charge of high schools, Julius Dix, reports to Cozy Marks. Working knowledge of the district's administrative structure is essential in order to understand the levels that must be kept informed. Teacher surveys require the approval of both the program and the administration associate superintendents. Activities that require the school time of teachers and/or students need a minimum of six weeks to obtain the necessary administrative approval.

St. Louis County has twenty-three school districts, not including the St. Louis Public Schools. Since 1980, the St. Louis Public Schools has carried out a court-ordered desegregation busing plan, which was begun within its borders. In 1982, the plan was expanded to include the voluntary transfer of black students from the city to county school districts, and white students from the county to the city's magnet schools.

The St. Louis Public Schools is composed of 127 schools, including 22 magnet schools. Some of the magnet programs are schools within a school. During the 1986-87 school year, district enrollment totaled 48,897 students.

During 1986-87, the St. Louis Public Schools employed approximately 3,840 certified staff members. Of the 104 mathematics teachers at the secondary level, 57 were female (34 black and 23 white), and 47 were male (15 black, 28 white, and 4 of other races). Thirty-nine of these teachers held master's degrees, thirty-one held master's degrees with thirty additional hours, and thirty-four teachers held bachelor's degrees. Eighty-six of the teachers were tenured and eighteen held probationary status. In addition to mathematics teachers, there were fourteen computer science teachers, all of whom were formerly mathematics teachers in the St. Louis Public Schools. The salary schedule in 1986-87 ranged from $19,097 for a beginning teacher with a B.A. to $36,680 for a teacher with an Ed.D. or Ph.D. who had reached the top of the schedule.

The Basic Essential Skills Test (BEST TEST) is one of the standards used within the district to measure students' mathematics achievement. This objective-referenced test is mandated by the State of Missouri to assess students' competencies in reading/language arts, mathematics, and government/economics. The test is administered annually to all eighth grade students and to high school students who have not passed a given portion of the test. In 1985, 1,331 students in grades 9-12 were required to retake the mathematics portion because they had failed it in eighth grade; this was the largest number of students ever required to retake any portion of the test. The percent of students passing the BEST TEST in mathematics has increased each year. In 1986, evaluation of high school students was expanded to include the administration of the Missouri Mastery Achievement Test. This test, in addition to demanding higher levels of skill, includes geometry items. In 1987, 86 percent of the students who were administered the test passed. The district also reported in May, 1987, that the scores on the California Achievement Tests have continued to show improvement. Between 44 and 46 percent of students in each of the four high school years scored above the national norm.

The secondary schools mathematics curriculum was revised during the 1986-87 school year; the last major revision occurred in 1976. The new curriculum covers topics from remedial mathematics through calculus. Beginning with the freshman class in 1985-86, students are required to have three years of mathematics in order to graduate. A sophomore remedial course entitled "Essential Mathematics Skills" was initiated in 1982-83. In 1983-84, another remedial course was initiated for ninth or tenth graders, called General Education in Mathematics. If students have not qualified to take algebra or basic algebra (algebra at a slower reading level and with less depth), they are placed in one of the remedial courses. Placement in freshman-level courses is based on students' CAT and BEST TEST scores. Teacher recommendations were considered in setting the standards for the tests. Higher-level mathematics courses are offered throughout the district, ranging from Basic Algebra through Calculus.

While the St. Louis Public Schools is considered not to have a shortage of qualified secondary mathematics teachers, there is a shortage of teachers with certification in mathematics teaching in the middle grades. Teacher morale is declining as the result of many issues, predominant among which is a new stipulation adopted by the School Board that students' achievement on the CAT be a major component of teacher evaluation. Teachers are therefore under considerable pressure to improve students' test scores or face the possibility of receiving unsatisfactory ratings on their own records. A main reason given for this policy is the need for improvement of the quality of instruction in the St. Louis Public Schools. The effort to use tests as a tool to weed out teacher incompetence has been challenged by the teachers' union. Some teachers have expressed the view that the practice of using test scores to evaluate teachers has also resulted in an increasing

reluctance on their part to participate in any activity that requires their absence from class because of the time this might detract from preparing their students for the test. The district, however, attributes improved student test scores to the introduction of more stringent accountability for staff.

With the coming of the new superintendent, Dr. Jones, in 1983, the Curriculum Division was reorganized and designed to have more than one mathematics supervisor. Under this new structure, a mathematics supervisor was first appointed in August, 1984. Since this time there have always been at least two mathematics supervisors, but there has been a turnover in the individuals filling these positions. In 1986-87, the two mathematics supervisors were Arissa Smith and Winifred Deavens.

C. Establishment of the Collaborative

The collaborative is funded through the Mathematics and Science Education Center (MSEC). The Center was formally initiated on January 29, 1986. Its Board of Directors was established in June, 1985, for the purpose of pursuing the Center's development. Judy Morton served as interim director until Dr. Paul Markovits assumed the directorship on August 18, 1986. Many of the Center's future projects may complement collaborative activities. During 1986-87, two MSEC advisory committees were formed, one for mathematics and one for science. Arissa Smith, mathematics supervisor for the St. Louis schools, serves on the Mathematics Advisory Committee. Judy Morton is an ex-officio member.

A conscious decision was made during its earliest stages that the collaborative would be planned by teachers for teachers. Thus, the planning committee that wrote the original proposal included nine teachers and the coordinator of a gifted program located in a regular high school, along with the interim director of the Center (Judy Morton), two staff members from the St. Louis Public Schools (the director of the Partnership Program and a mathematics supervisor from the Curriculum Services Division), and a mathematics coordinator from one of the St. Louis County school districts, who served as a consultant. The teachers and principal were recommended by the director of the Partnership Program and the mathematics supervisor.

The collaborative is directed by the Collaborative Council, which was established in the fall of 1986 to provide direction for the collaborative. By the end of the 1986-87 school year, the Council was comprised of ten teachers, three administrators from St. Louis Public Schools, a university mathematician, and Judy Morton, project director. The administrators are Wayne Walker, director of the Partnership Program since its inception in 1982; Arissa Smith, mathematics supervisor in the St. Louis Public Schools since 1984; and Winifred Deavens, mathematics supervisor since 1985. Ms. Morton, the collaborative director and a former

secondary teacher, has consulted in educational technology and computer applications, as well as served as a project administrator. James Richmond, a high school mathematics teacher in the St. Louis Public Schools, is the on-site observer.

The staffing of the Collaborative Council with its teacher members took place over an extended period of time; the teachers were those who indicated interest in the collaborative by attending Council meetings. At the October 14, 1986, monthly mathematics department head meeting, sponsored by the school district and held at the St. Louis Science Center, the department heads were asked to encourage teachers to become involved in the collaborative and to attend the first Collaborative Council meeting on October 30. At the October 14 meeting, Judy Morton talked about the collaborative and gave each department head materials about the collaborative to distribute to each mathematics teacher in their schools. In addition, Paul Markovits talked about the Mathematics and Science Education Center and Wayne Walker talked about the Partnership Program. All secondary mathematics teachers were notified and invited to come to the first Council meeting on October 30, held at the University of Missouri-St. Louis. About twenty teachers were expected to attend. A total of six actually attended, including two mathematics teachers. The meeting was designed to provide teachers an opportunity to plan professional activities in which they would like to participate during the 1986-87 school year. At this meeting, the purpose of the collaborative was discussed, along with site visits to businesses, internships, advanced study, project and program development, a series of speakers, and a newsletter.

A second meeting of the Council was held November 19 at 3 p.m. at the Missouri Botanical Gardens. Four teachers, as well as the project director, attended. At this meeting, other potential collaborative activities were discussed, including grant-writing assistance, workshops at the Missouri State Teachers Association Teaching Academy, participation in the EQUALS Program, and participation in projects from the National Diffusion Network. From November through May, the Council met once each month.

By March, 1987, eight of ten teacher positions on the Collaborative Council were filled and interest among teachers in the two remaining positions had increased substantially. The Council, composed of the eight teachers, the two mathematics supervisors, the Partnership Program director, and the collaborative director, then invited two university professors to participate. Dr. Richard Friedlander of the University of Missouri-St. Louis accepted. In addition, a representative from the St. Louis Public Schools' division of Technology Development will begin to serve in fall, 1987. The Council will also discuss the inclusion of two business and industry representatives in fall, 1987. Council teachers have been careful to maintain a sense of group identity for the collaborative. This sense of group membership for the collaborative has required that the Council expand slowly in terms of number. However, those who did join have

been very committed to the project since their initial participation. These teachers want the project to be one that addresses the specific needs of teachers in the St. Louis Public Schools. This is in contrast to other area projects, which also include teachers from the county school districts. As a result, the Council will add representatives from other sectors relatively slowly until the teacher members are more comfortable with the direction being taken by the collaborative.

In February, the meeting time for the Council was set for the second Wednesday of each month. Topics discussed by the Council at meetings throughout the spring of 1987 included grants, workshops, site visits, collaborative relationships with universities and colleges, the newsletter, and preparations for the 1987-88 Mathematics Contest and Mathematics Fair. Reactions to the Council meetings have been very positive. After one meeting, a teacher commented, "People had good ideas and everyone was informed of this meeting." Another said, "This meeting should allow teachers to get to know each other better." Winifred Deavens, Math Supervisor, noted, "I had several items to input at this meeting, and I am happy to say that they were all received and acted upon."

In addition to having a close working relationship with the Mathematics and Science Education Center and the St. Louis Public Schools, the mathematics collaborative has the support of seven corporations, three universities and colleges, and four foundations and other cultural associations.

D. Relationship with Other Local Initiatives

During the past five years, the St. Louis Public Schools has intensified its efforts to involve a variety of community sectors in improving the academic achievement of its students and the professional development of its staff. The School Partnership Program develops instructional programs to reinforce and to enrich the curriculum using the expertise of volunteers from business and industry. These multisession programs encompass and reflect the instructional goals of the teachers and demonstrate to students the work-world applications of the skills they are acquiring in school. These programs are conducted in the classroom and at different sites throughout the community.

The Mathematics and Science Education Center is responsible to its own Board for its activities. A policy board directs the Network for Education Development of which the MSEC is a division. The chairman of the MSEC Board sits on the Network Board. There also exists a Policy Board for the Cooperating School Districts, of which the Network is a division. Although subordinate boards do not need approval of higher boards for their

activities, it is expected that all projects are coordinated with an overarching goal of assisting schools and districts in educating their students in the best manner possible.

E. Project Activities

The activities sponsored by the St. Louis Mathematics Collaborative during the 1986-87 school year are described in the section "Collaborative Sponsored Activities." In addition to these activities, the collaborative also promoted teacher participation in a variety of activities that were sponsored by other organizations, but were related to fulfilling the goals of the collaborative. These are described in the section "Collaborative Supported Activities."

COLLABORATIVE SPONSORED ACTIVITIES

Site Visits

In the summer, 1986, the collaborative organized site visits for teachers at three area businesses. Five teachers participated in each visit. At the morning sessions, teachers were presented information about the business, about how mathematics is used in the business, and about the mathematics prerequisites demanded of new employees. Participating businesses provided lunch for the teachers and business associates. In the afternoon, each teacher accompanied a business representative to observe the use of mathematics in the workplace.

Resource Materials

During the summer of 1986, five groups of four or five teachers each spent about thirty hours compiling resource lists. Twenty-one teachers participated. Each group was responsible for identifying resources in one of five categories: people/organizations, information exchange among schools via data communications, books and journals, videotapes and films, and computer software. The intent is to distribute this booklet of the completed lists to all mathematics teachers. The booklet was not completed during the summer of 1986 and work on it will continue during the summer of 1987.

Effective Teaching Conference

In August, 1986, the collaborative paid $100 for each of six teachers to attend an all-day conference on Effective Teaching presented by the Missouri State Teachers Association. The conference was held at the Omni International Hotel in St. Louis.

Grant-Writing Seminars

On December 3, 1986, the collaborative sponsored for secondary school mathematics teachers a grant-writing seminar held at the La Veranda Restaurant in St. Louis. Two grant programs available to teachers in the St. Louis Public Schools were discussed: The Incentives for School Excellence Program, sponsored by the State Department of Education; and Southwestern Bell Mini-Grants, sponsored in conjunction with the St. Louis School Partnership Program. Tom Prater, Assistant Director of the Missouri Facilitator Center, discussed the National Diffusion Network facility, which serves Missouri teachers who seek access to various national educational programs. Mr. Prater brought with him an extensive display of mathematics materials, books, curriculum guides, and sample proposals for the teachers to examine while he spoke. He also offered to send materials to teachers interested in using the Facilitator Center, and to return to the collaborative on a future date to spend additional time helping mathematics teachers become aware of opportunities to bring enrichment programs to St. Louis. Tom Odneal, Department of Elementary and Secondary Education for the state of Missouri, talked about how to write grants for federal funds that were available through the state department. A total of fourteen teachers attended.

A second seminar on grant writing was offered to teachers on January 21, 1987, from 3-5 p.m. at the Partnership Program Office auditorium. Presenters Tom Prater, from the Missouri Facilitator Center, and Sally Logan, of the St. Louis Science Center, informed teachers of the availability of grants and encouraged them to write proposals. Small grants for up to $250 were available from Union Electric and could be applied for through the Science Center. Teachers were also advised of the editing and typing services available to them through the Mathematics and Science Education Center. Seven teachers attended. The low turnout was attributed in part to conflicting programs in the school district.

Participants enjoyed the session, although some pointed out that the seminar's content did not match its title of "Grant Writing." The presenters talked more about available resources for grants rather than how to write a grant. Other teachers suggested that the seminar was announced too late. One teacher said, "This can be useful. Provide more time for hands-on activities with the system used. Get the date of planned workshops such as this to us well ahead of time so we can help with attendance." A second

teacher commented, "[It provided] interesting information about creative writing methods, but would have been a disappointment to anyone expecting tips on grant writing. Choose the title to reflect contents of the workshop. Perhaps we should endeavor to have tentative responses from potential audience as to know how many people to expect." A third teacher said, "The Missouri Facilitator Center seems too good to be true. St. Louis teachers should use their suggested programs. Teachers who use these programs should 'show and tell.'"

After-School Social

On April 2, 1987, the St. Louis Mathematics Collaborative sponsored an after-school social get-together for all secondary school mathematics teachers at the Forest Park Hotel. The event was designed to help teachers become better acquainted and to provide them with information about the benefits of collaborative participation. Twenty-one teachers attended.

Collaborative Newsletter

The one issue of the St. Louis Collaborative Newsletter, edited by on-site observer James Richmond, was available to teachers in mid-March 1987. One hundred-fifty copies of the newsletter were distributed among department heads at their March meeting to be given to teachers in their departments. The issue announced a contest open to all St. Louis secondary mathematics teachers to design a logo for the collaborative's newsletter. Contestants had to provide an explanation of how the logo and the name related to the focus of the collaborative. A $50 cash prize was to be awarded to the winner. Five entries were received, but the prize will not be given until a more extensive newsletter can be printed. Until this happens, articles on the collaborative are included in other regular St. Louis Public Schools publications. In addition, the minutes of each monthly Collaborative Council meeting are distributed to each mathematics teacher as well as to other school administrators. These minutes keep the teachers apprised of collaborative events and activities.

COLLABORATIVE SUPPORTED ACTIVITIES

Reception for the New Mathematics and Science Education Center Director

A reception for Dr. Paul Markovits, the newly appointed director of the Mathematics and Science Education Center, was held January 28, 1987, at the Missouri Botanical Gardens. This event was publicized by the collaborative and all mathematics teachers